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Electrical World

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Practical Way to Save Coal

EVER since 1917, when the industries of the country were brought face to face with the acute coal situation, there has been a lot of loose talk on coal conservation. Whenever an effort was made to save fuel, the policy of the administration was—and it still is—one of repression, such as heatless days, lightless nights and curtailed production of the less essential manufactures. These were drastic yet effective measures. The statistics on the large generating systems of the country which are published in this issue reveal a more democratic method of conserving fuel; that is, through water-power development. The energy generated in 1918 by the hydroelectric companies represented an equivalent saving of over 30,000,000 tons of coal, and the transmission of the energy represented a saving in the hauling of approximately 750,000 carloads, not to mention the use of thousands of cars and the labor involved in mining and transporting the coal, or the enormous amount of fuel which would have had to be burned in the locomotives to pull the coal from the mines to points of distribution. Considering the rapidity with which our coal reserves are being depleted and the increasing demands for power by the expanding industries of the country, the necessity for more water-power development is apparent.

If reconstruction is to bring the greatest possible measure of comfort and happiness to the individual, electrical engineers must dedicate themselves to new and national purposes founded upon fellowship and love, so that the new social order shall not be based on antiquated notions but on scientific investigation.

Standardization and Its Limits

THE movement to replace the British standards of weights and measures, which are also the American, by the metric system used by the people of the other Western nations and favored by engineers all over the world has against it only human inertia and the inconveniences inseparable from the act of change. Once in operation and with right-of-way in the elementary schools, it would vindicate itself so quickly that the loud protests of the conservative would dwindle to murmurs and the murmurs be swallowed up in an approving chorus. For in the field of mathematics no one ever favored a more difficult as against an easier method of accomplishing the same result, and it would be as reasonable to clamor against decimal coinage or the Gregorian calendar as to oppose, after the accomplished fact, a change so manifestly in the interest of science and of economy in time and labor.

The metric system, if it shall become universal, will make easier the work of any league of nations that the future may have in store, for it will remove the one element needing translation in the science of mathematics, which otherwise has ever since the universal adoption of the Arabic notation needed no interpreters to make it international; and in modern civilization mathematics plays at least an equal part with literature. It is, however, vastly significant that what took place so spontaneously and rapidly in the mathematical world not all the efforts of ardent advocates have been able to accomplish in the world of language. Volapük and Esperanto, artificially procreated, were born dead, and no one has been able to galvanize their infant corpses into life. Language mirrors a nation's soul. It is the medium of imagination and poetry. It expresses the nice differentiations of race and history, of climate and environment. It will change with the slow procession of the centuries, but not even for the purposes of business communication can it be standardized.

Turn from the international to the national arena and analogy holds its own. In the sphere of tangible, ponderable things standardization keeps step with the march of civilization. In a nation where every railroad used a different gage for its tracks, where no two gas or water pipes had the same diameter or no two electric-lamp sockets the same thread, where no tool could be easily duplicated and no part of a machine, a vehicle or an appliance readily replaced, every fresh invention would bring in its wake fresh sources of annoyance and expense. Even private monopoly, if that be the price of mechanical uniformity, will be welcomed in order to obtain it. But when, building on this truth, would-be standardizers reach out their dead-leveling hands toward the intangible and the inscrutable, they are proceeding by a false minor premise to a conclusion at variance with wisdom. Human hands and human brains cannot be standardized nor the personal equation ignored. To standardize education is to sterilize it. To standardize literature or music, art or architecture, is to destroy it. To take mental or manual endeavor on less ambitious lines and set a pattern, a system or a pace to which all doing similar work in a laboratory, an office or a workshop must conform is to discourage ability and subserve mediocrity. Some so-called "efficiency engineers" have been guilty of this mistake in an effort to increase production; many leaders of trade unions have been guilty of it in a desire to keep production down. Man is not a machine. Procrustes with his rule-of-thumb method for standardizing human stature has no place in modern industry. Attempts to emulate him, especially in a great individualistic democracy, are foredoomed to failure, though unhappily not free from harm.

What a horrible mess the administration has made of the operation of the transportation and communication systems and how typical of municipal ownership are the results! To paraphrase the epitaph of Sir Christopher Wren, "If you seek a monument to government inefficiency in ownership and operation, look around."

Continuous-Wave Land Radio Sets

EVERY great war brings some new weapon to the front. If we except the airplane, this war has given birth and permanent use to the tank, which was the reply to the machine gun. Once the tank was launched or set going, means had to be found to maintain communication between it and its base. Radio communication is the only kind of communication which can at present hope to meet all the requirements. Nevertheless, the difficulties in the way of providing tank radio communication are very great. A tank is a very near approach to Faraday's hut, or metallically inclosed chamber, which he showed to be a complete electromagnetic wave-proof receptacle. Special pains have to be taken to bring radio signals into its sheltered interior. A radio system developed by the Signal Corps for meeting, among other needs, the exigencies of the wayward tank is described in this number by Lieut. Paul T. Weeks and Lieut. Donald G. Little. This system is very interesting and involves for its successful application the vacuum tube, both in the transmitting and receiving sets. The system is indeed a good illustration of the great importance of the vacuum tube in modern radio communication.

Daylight saving becomes effective again next Sunday at 2 a.m., and it is expected that every one, including central-station managers, will make the best use of the extra hour of daylight. Whatever benefits humanity benefits the central station also.

The Super-Transmission Plan

THE discussion by W. S. Murray of the plans of the Secretary of the Interior for supply of power on the Atlantic seaboard which we present this week is both inspiring and instructive. As regards the necessity of developing great power networks to take care economically of our needs, we have hammered away in season and out of season, and it is somewhat encouraging at last to have the practical side of the matter taken up in a way which affords at least a possibility of results. The conception of a great transmission system reaching from Portland, Me., to Richmond, Va., as Mr. Murray presents it, is certainly an appealing one. It involves no technical difficulties of any material account, the only question being the financial one, which in government hands would easily be settled, and the administrative one, which might involve serious conflicts of interest with privately owned enterprises. We do not believe that the government will be permitted by the people, even if it wished, to seize the power transmission systems as it has already grasped the communication systems. There is a limit to government ownership in principle and in practice, so long as this country holds to the ideals of its founders; but there is no reason why a government-owned—or, better, government-controlled—system linking the great power enterprises of the Atlantic coast could not and would not be a success. Its installation should mean that it would tap every distributing network all along the line on a system of exchange of power which would enable the steam-driven and the hydraulic stations to coöperate to the best possible advantage in utilizing the diversity factor of the whole system.

That very great gains in the saving of fuel and expense could be made by electrification of many of the railway lines is now indubitable. Mr. Murray's own experience is sufficiently conclusive on this point, and it is thoroughly backed by the results of others. The enormous cost of the necessary changes and the fact that most railroads are up to their eyes in debt have been the two stumbling blocks in the way of general electrification. The condition of the railroads, under whatever ownership, must be greatly stabilized before one can talk seriously of an addition in any form to the already huge interest charges, even for the purpose of effecting economies; but, with a firmly established power linkage all along the Atlantic coast, the task of electrification will become vastly easier. The only point on which we are disposed to call in question Mr. Murray's admirable statement of the case is the proposition of tying up this huge enterprise to 25 cycles. Why depart from the usual frequency of 60 cycles in an attempt to tie together the electrical developments along the Atlantic seaboard? At best choice between the two is a somewhat difficult matter of quantitative investigation with an eye to the future as well as to the past, and it should be considered an open question until the real rôle of the super-transmission system is finally determined. One matter with respect to transportation itself has a direct bearing in this connection, and that is the desirability of taking care of the distributed floating load of a railroad system from existing power networks backed up by the super-transmission scheme. The solution of the power problem of distribution for transportation involves too elaborate and complete a study of the situation as to load distribution to be solved, even approximately, offhand. This, however, constitutes no reason why the project should in its earlier stages be delayed.

The obligation to improve service rests on every public utility operator. There is little virtue in remedying defects brought to one's attention. First-class service is expected, and it is better to merit the praise of customers through continual improvements rather than their censure because of shortcomings.

Technical Education

IT SEEMS to be generally accepted that the pupils who graduate from the technical colleges are not so proficient in their cultural, scientific, economic and practical attainments as might be desired. Here all agreement seems to end. All manner of suggestions are forthcoming as to the causes, remedies and consequences of this admitted fact.

It is doubtful whether the technical colleges could ever satisfy the desires of the engineering profession, under any set of conditions that are within reasonable hope of fulfillment. Leading engineers are apt to forget how many years ago they themselves graduated from college, and how much hard work, study and self-development they have undertaken since that event. It is but natural that in their aspirations for the prestige of their profession they should be impatient with

the young fellows just commencing at the bottom of the ladder of toil and should hold the colleges to blame for not producing genius full-fledged and competence complete.

From the standpoint of the colleges, they meet the need of criticism with a stare of astonishment. Of all the students who enter their portals with the avowed intention of becoming engineers, only about one-third succeed in graduating into the profession. The two-thirds either revoke their purpose or fail. The colleges are apt to wonder what the professional comment might be if the whole band of original endeavorers were to receive diplomas. Moreover, the colleges witness so great a change, growth and development in the students during the customary four years of study that they wonder what the professional judges would say to the freshmen, if they have so little praise for the graduates.

In a democracy the avenues to all of the professions lie open to all pretenders. Nevertheless, native ability sufficient to win professional distinction is allotted to only a small minority. Many are called but few are chosen. Let us rather be content that the many who are ungifted offer themselves for training. No matter how ungifted the student, he gains something by the training. Why should the cup of gratitude be filled with discontent? In the vast world of business, of engineering and constructive accomplishment there is abundant room for every grade of engineering talent and technical ability. It would even be a great misfortune if all of the graduates of all of the technical colleges were great engineers. As in the army, to every commissioned officer there must needs be at least several non-commissioned officers. To every leading engineer in the profession there should probably be at least a dozen honest and worthy engineering aides of lesser capability and skill, whose work is nevertheless vital and essential to the enterprise in which all are engaged.

Scoffers at theory should ponder the devastating results secured in the bombardment of Paris by the German long-range artillery, now that the censorship has been lifted on this matter. "Cut-and-try" methods have their place, but in the long run the ability to predict performance on paper is worth a vast amount of "educated guesswork."

Compensated-Type Potential Regulators

IN ORDER to hold the voltage automatically constant in an alternating-current circuit at some point remote from the generator, under varying conditions of load, an automatic regulator must be introduced which shall be capable of responding not only to the strength but also to the phase of the current supplied by the generator to the circuit. A. H. Ford, P. E. Mead and G. W. Thomas present in this number a graphical outline of the conditions which have to be met to bring about automatic regulation at a remote point.

An interesting case under the general rule of automatic regulation is that of a synchronous motor so controlled by the regulator as to keep the power factor constant in the system to which it is connected. Two aspects of a self-regulating system call for consideration. The first is that which relates to the conditions under which a regulator can perform its assigned functions. This is the aspect dealt with in the article here considered. The second is that which relates to what may happen in the system if the automatic regulator should accidentally suspend its functions and cease to operate effectively. Accidents may occur in the best regulated systems. It is important to make sure that, in the worst case, the regulation cannot become defective beyond a definitely assigned limit should the regulator become deranged. In some cases this particular aspect of the system has been overlooked, with unfortunate results.

The harbor strike has threatened the operation of public utilities in New York by depriving them of coal. This is one reason, and a very good one too, for storing coal, and no public utility manager can shirk the responsibility with impunity.

Opportunity and the Associated Manufacturers

NOW starting on its fifth year, the Associated Manufacturers of Electrical Supplies faces opportunities just as great for its members as those which led to the organization of this body. The proceedings of the annual meeting which is reported in this issue are only a partial presentation of the real work which has been done and is planned for the future. They relate more particularly to the general activities of the association than to the detailed affairs of the sections. It is through the twenty-five sections that results are accomplished which touch directly the individual lines manufactured by the members. The central organization of the association serves to weld the sections together firmly. It also acts to superyise or criticise, if criticism be needed, the sections. Its approval is required before the action of sections becomes final. Through this effective method of organization the sections conduct intensive work on the lines approved by the general counsel of the association and by the board of governors and the main body carries on the general affairs which touch all members. Last year these affairs were of course very largely matters of national war service. There was also, however, the subject of international trade, which is in charge of an efficient committee that is getting results. The extensive efforts of the association to render service to the country during the war illustrate effectively what can be accomplished through true coöperation. And the comprehensive program of the international trade committee is a conspicuous example of what can be done to safeguard and extend the electrical manufacturing industry.

Certainly there is more need than ever before that an association of this character shall exist and grow. Its record in accomplishment is the best index of what it may do in the future years. Its grasp of problems, its recognition of conditions, is the arrow pointing to the way in which it will face the issues of these times. With many minds meeting there is always the chance of conflicting views as to detail. But on the large questions of principle the members of the association have stood together. Conceived and launched at the moment of psychological advantage, the association has been ably directed from the beginning. It has foreseen changes in conditions, it has been ready to meet new situations. It is to-day keenly aware of the economic tendencies of the era and appreciative of the opportunities arising in them. There is no evidence of desire to ignore or minimize the adverse factors or to exaggerate the favorable influences. The association seeks the facts as a foundation for its policy.

Compensated-Type Potential Regulators

Correct Connections for Using Compensated Potential Regulators for Power Factor and Voltage Correction at Load Are Discussed—Action of Regulator Also Depends Upon Line Constants as Shown by Tests

BY ARTHUR H. FORD, PAUL E. MEAD AND GUY W. THOMAS
State University of Iowa, Iowa City

THOUGH automatic potential regulators have been in general use for a number of years, it is a common experience to find them unused on power-station switchboards, and still commoner to find the compensated type of regulator with the compensating winding out of use. Upon investigation of unused regulators it is usually found that the compensating winding is incorrectly connected or adjusted.

In this article an analysis of the principles of operation of this type of regulator is set forth, showing the necessity for correct connection. It is also shown that exact regulation at the load may only be realized when line resistance and reactance bear a definite ratio. In some instances it may be advisable to add to the line reactance to improve regulation. Test data obtained with a Tirrill regulator bear out the conclusions.

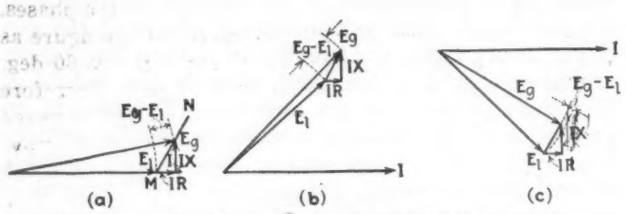


FIG. 1—VECTOR DIAGRAM FOR SINGLE-PHASE SYSTEM
(a) Non-inductive load. (b) Lagging current. (c) Leading current.

A necessary part of most automatic potential regulators is the contact-making voltmeter. This consists essentially of a magnetizing coil connected in series with a non-inductive resistance, the two being connected across the line the voltage of which is to be regulated. Where a single coil voltmeter is used, without a line drop compensator, it should be connected to the line at that point at which it is desired to have the voltage held constant. This commonly requires that the regulator be placed at such a location that it is not easy of access. Ease of inspection makes it desirable that the regulator be installed either in the power station or a substation, such a location being necessary in the case of a regulator which controls the line voltage by controlling the exciter of generators or synchronous motors.

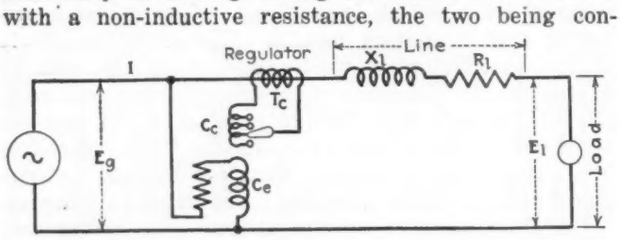


FIG. 2—CONNECTION OF REGULATOR IN SINGLE-PHASE LINE

The limitation of the point at which the voltage is controlled to that location at which the contact-making voltmeter is connected can be obviated by making use of some device which will automatically take account of the line drop in its correct phase position. This condition is commonly brought about by adding a series or compensating coil to the contact-making voltmeter and connecting this coil to the secondary of a current transformer connected in the line to be regulated. The widely used compensated Tirrill regulator is of this type.

REGULATION OF SINGLE-PHASE LINES

The connection diagram for the voltmeter coil of a Tirrill regulator, a generator and a single-phase transmission line are shown in Fig. 2. C_e is the voltage coil of the regulator and C_c the current or compensating coil, both being wound so as to act on the same core.

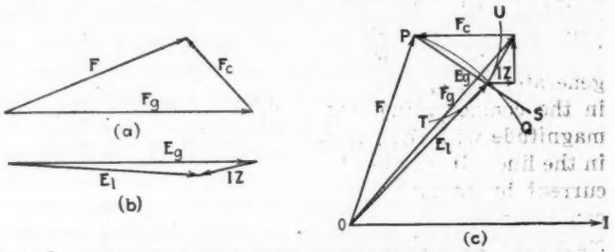


FIG. 3—FORCE TRIANGLE FOR CONTACT-MAKING VOLTMETER AND VOLTAGE VECTOR DIAGRAM

T_c is the current transformer supplying current to the compensating coil. X_l and R_l represent a line having reactance X and resistance R. E_g is the generator voltage and E_l the load voltage.

The voltage and current relation for the above line and loads of various power factors are shown in Fig. 1,

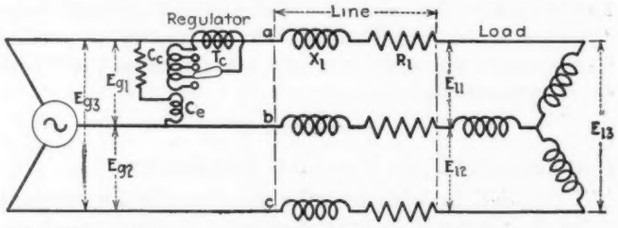


FIG. 4—CONNECTION OF REGULATOR IN THREE-PHASE LINE

when the line is composed of No. 000 copper spaced 3 ft. (90 cm.) apart, having a resistance drop of 15 per cent and operating at 60 cycles. Fig. 1 (a) shows the relations for non-inductive load, (b) for lagging current and (c) for leading current. If it is assumed that the load potential E_l and the power factor remain constant as the current changes, the locus of E_g in the line MN and the necessary change in the generator potential is $E_g - E_l$. This is seen to be proportional to I only in case the line reactance is negligible as compared to the resistance and the power factor is unity, or in case the ratio of reactance to resistance of the load is equal to the ratio of reactance to resistance of the line.

For any other values of the line and load constants the difference between the generator and load voltages

is less than the line drop and does not vary directly with the current.

The compensated regulator, when connected as shown, will hold the voltage at a distant point constant only when the above conditions are fulfilled, making the pull

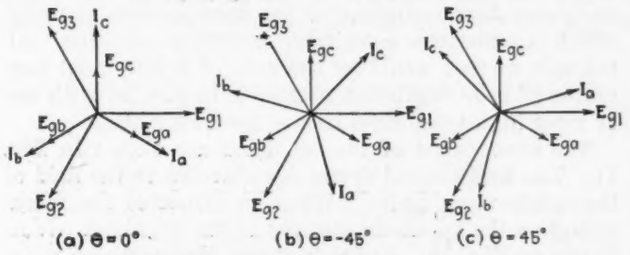


FIG. 5—CURRENT AND VOLTAGE RELATIONS IN THREE-PHASE LINE

on the voltmeter core proportional to the voltage at the distant point. This requires that magnetizing action due to the compensating coil shall be directly opposed to that due to the voltage coil.

The general condition is shown in Fig. 3, where *a* represents the force triangle for the contact-making voltmeter and *b* represents the voltage triangle for the transmission line. F_g is the force due to the current in the voltage coil, which is directly proportional to the generator voltage. F_c is the force due to the current in the compensating wind, which varies in phase and magnitude with the phase and magnitude of the current in the line. It may be changed in magnitude for a given current by changing the number of turns in the compensating coil. F is the resultant force, which must remain constant with a constant adjustment of the control spring or counter weight of the regulator.

Since F_g is proportional to E_g, these two triangles can be combined as shown in Fig. 3c, if the scales are properly chosen. F being constant, the condition of E_l being constant is fulfilled if the locus of the end of E_l is the circumference of the circle PQ having O as its center. F_c and IZ being both directly proportional to I and not changing their angular position, as long as the power factor remains unchanged, the locus of E_l is the straight line PS, when the current changes without change in power factor, and the circular arc TU, having P as its center, when the power factor changes without change in current. Since the length of F_c can be varied, by changing the number of turns in the compensating coil, it is possible to make the circular arc TU and the straight line PS cut the circular arc PQ at the same point and thus make the compensation perfect for a given current and power factor. E_l will be too low for currents or power factors less than these and too high for currents or power factors greater than these.

CONNECTION FOR THREE-PHASE LINES

When a compensated regulator is used to regulate the voltage on a three-phase line the action is similar to that just described, provided the voltage coil is connected so as to have the Y voltage of the line in which the current coil is connected impressed on it. This is seldom done, the common practice being to connect the voltage coil so as to have the delta voltage impressed on it, as indicated in Fig. 4. This complicates the problem of making proper connections, because the line currents are not in phase with the delta voltages, and raises the question which line should have the current transformer supplying current to the compensating coil connected to it. The current and voltage relation for a three-phase circuit with unity power factor, lagging and leading current are shown in Fig. 5. Of the three possible locations, the placing of the current transformer in the lead to which the potential coil is not connected is obviously incorrect; for this current I_c will be at approximately 90 deg. phase displacement from the voltage E_{g_1} when the power factor is about unity, and therefore it can change a large amount without affecting the pull on the voltmeter core to an appreciable extent. Of the currents in the other leads, I_b lags behind E_{g_1} by 150 deg., while I_a reversed leads E_{g_1} by 150 deg. with the power factor unity. Where the load has unity power factor and the line has a negligible reactance, either of these currents is equally effective in compensating for line drop.

When the line reactance is negligible, the current transformer should be placed in line *b* in order to obtain the best results. This is shown by reference to Fig. 6, which is similar to Fig. 3 except that at unity power factor the current I_b is 150 deg. behind E_g and the line reactance is such that the angle between IZ and IR is 30 deg. The magnitude of E_l is $E_g - I_aZ + I_bZ$. With the above constants this makes the angle between E_g and the total line drop equal to 30 deg. when the load is non-inductive and balanced among the phases.

This can be proved from the geometry of the figure as follows: The angle between $-I_aX$ and $-I_aZ$ is 60 deg. The angle between $-I_aR$ and I_bR is 60 deg. Therefore $-I_aX$ and I_bZ form a straight line. The angle between E_g and I_bZ is equal to 60 deg. $-I_aZ = I_bZ$ in magnitude, and therefore the triangle $-I_aZ, I_bZ, (I_b - I_a)Z$ is isosceles and the angles next to $(I_b - I_a)Z$ are equal and have their sum equal to the angle between E_g and I_bZ. This makes the angle between E_g and $(I_b - I_a)Z$ equal to 30 deg.

Now, drawing the force triangle for the contact-making voltmeter, it is seen that the angle between F_c and F_g is 30 deg., if the current coil is connected in lead *b*. The magnitude of F_c can be so adjusted that F_c coincides with $(I_b - I_a)Z$, when F will coincide with E_l. The voltage at the far end of the line will therefore be constant for all loads, no matter what the power factor, as long as the adjustment of the contract-making voltmeter is unchanged.

TESTS OF REGULATION OF THREE-PHASE LINE

The above deductions were checked experimentally by the use of a three-phase generator and an artificial transmission line.

The accuracy of control of the voltage by the Tirrill regulator was checked by connecting the voltage coil only and measuring the busbar voltage when the load was changed. It was found that the voltage remained constant, within the limits of accuracy of the ordinary

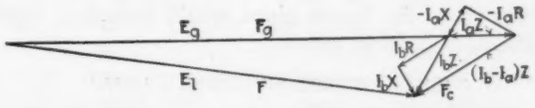


FIG. 6—DIAGRAM OF FORCES ACTING ON CONTACT-MAKING VOLTMETER

switchboard-type voltmeter, for various loads and power factors.

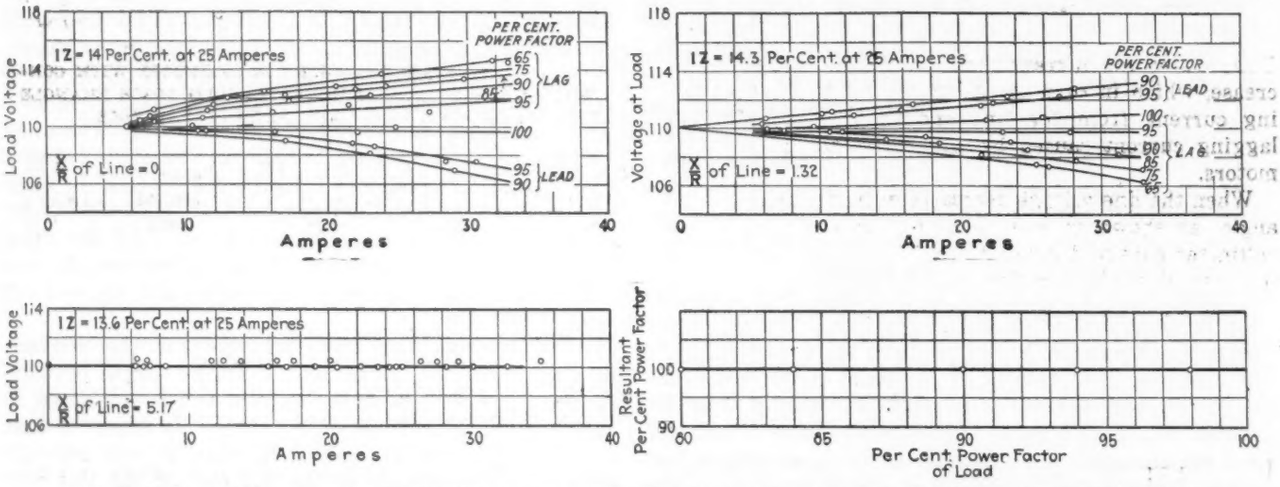
A line having sufficient resistance to give a drop of 14 per cent at 25 amp. load and having no reactance was then connected to the generator busbar. The compen-

sating coil on the regulator was then adjusted so as to make the no-load and full-load voltages at the load end of the line equal, the load being non-inductive. The load current and power factor were then varied and the load voltage was read. The results indicated in Fig. 7 were obtained. This shows that exact regulation is obtained only for loads having substantially 100 per cent power factor.

The resistance of the line was then reduced to 0.385 ohm and a reactance of 0.199 ohm added. This makes the angle between resistance drop and impedance drop in the line essentially 30 deg. The line drop is 13.6 per cent at 25 amp. The adjustments were made as before, and the load and power factor varied through the same range as before. The results are plotted in Fig. 9. This gives exact regulation for all loads and power factors.

The resistance was then decreased to 0.272 ohm, and the reactance increased to 0.358 ohm. These values give a line drop of 14.3 per cent at a load of 25 amp. Similar adjustment and tests give the results shown in Fig. 8.

A comparison of these results with the theoretical deductions shows exact agreement. One peculiarity



FIGS. 7, 8, 9 AND 10—TESTS OF REGULATOR UNDER DIFFERENT CONDITIONS OF LINE CONSTANTS AND POWER FACTOR

Fig. 7—Line has zero reactance. Fig. 8—Line has $r = 0.272$ ohm and $X = 0.358$ ohm. Fig. 9—Exact regulation obtained when $x = Z/2$. Fig. 10—Exact power-factor correction is automatically obtained by use of regulator.

which warrants special attention is the fact that the voltage is too high for a lagging current when the line reactance is less than $0.5R$ and for a leading current when the line reactance is greater than $0.5R$. This brings out the fact that a compensated regulator of the type investigated cannot be adjusted to hold the voltage exactly constant at the far end of a transmission line unless the line reactance, including that of the step-up and step-down transformers, is equal to one-half of the line resistance, including the transformers. The insertion of sufficient additional reactance to bring the total reactance up to the figure given would therefore seem to be advisable in some cases.

THE CONTROL OF POWER FACTOR

When discussing the question of the proper line into which to insert the transformer which supplies current to the compensating coil, it was pointed out that the current I_c, in line c, had such a phase relation to the voltage E_{g_1} that changes in magnitude of the current had little effect on the total force acting on the voltmeter core. A change in phase angle of the current, however, produces a relatively large change in the force acting on the voltmeter core. This fact can be made use of to hold the power factor on a transmission line at about unity by means of a synchronous motor controlled by a compensated regulator. Such a connection can also be used to hold the power factor of one of several synchronous generators, connected to the same system, at unity, which is sometimes a desirable operating condition. An example of this would be the case of a low-speed generator of poor regulation operating in parallel with one or more high-speed machines of good regulation.

The connections of the regulator are shown in Fig. 11. The field control device is connected to the field of the synchronous motor. When so connected the forces acting on the voltmeter element of the regulator are as shown in Fig. 12. Fig. 12a shows the condition when the current and Y voltage are in phase (power-factor unity), b when the current is lagging, and c when the current is leading. F_g is the force due to the current supplied by the shunt transformer and is proportional to the generator voltage E_{g_1}. F_c is that due to the current derived from the series transformer and in proportion to the line current I_c. F is the resultant force and is equal to the vector sum of F_{g_1} and F_c. When the regulator is properly adjusted, it will act in such a manner as to keep F constant in value, for the pull of the solenoid is balanced by the pull of a spring. The internal connections of the regulator are such that the excitation of the motor will be increased when F is reduced in value and decreased when it is increased in value. It should be noted that the current transformer is placed between the synchronous motor and the load having the low power factor. This location is necessary because the leading component of current drawn by the synchronous motor must be equal to the lagging component of the current drawn by the other apparatus. The operation of the regulator should therefore depend on the current for which it is desired to compensate and not on the current taken by the synchronous motor or that supplied by the generator. When it is desired to hold the power factor of a given generator, of a number connected in parallel, at unity, the current transformer must be placed in the circuit of that particular generator.

When a synchronous motor is placed at the end of a feeder supplying a motor load, there will in general be a change in voltage and a change in power factor inde-

pendent of the operation of the synchronous motor. It is therefore necessary to consider the effect of each of these changes on the operation of the motor when connected as shown in Fig. 11.

When the lag of the current increased, without a change in voltage or current magnitude, as shown in Fig. 13a, the pull on the voltmeter core changes from F to F'.

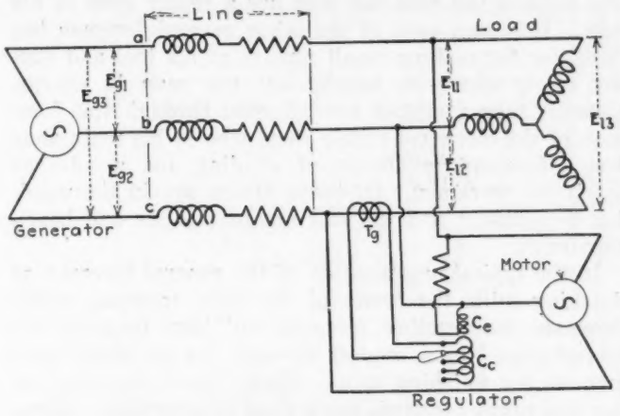


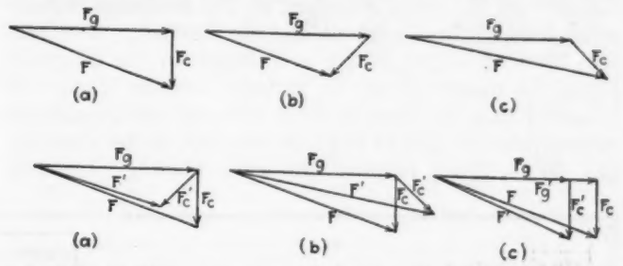
FIG. 11—CONNECTION OF REGULATOR AND SYNCHRONOUS MOTOR FOR POWER-FACTOR AND VOLTAGE REGULATION

This causes the current through the motor field to increase, which in turn causes the motor to draw a leading current from the line and thus correct for the lagging current caused by the operation of the other motors.

When the line voltage decreases without change in lag angle, as shown in Fig. 13c, the force acting on the voltmeter core is decreased from F to F', which causes the excitation of the motor to increase and thus increase the line voltage by drawing a leading current from the generator. An increase in the line voltage produces the opposite effect. A variation in load, power factor and voltage remaining constant, has scarcely any effect on the length of F, as shown in Fig. 13b, and therefore it does not affect the operation of the synchronous motor.

TESTS OF POWER-FACTOR CORRECTION

The above deductions were checked by putting the same load in amperes on a generator and adjusting the power factor to various values. A synchronous motor connected to the Tirrill regulator was then put on the line and the power factor and voltage were noted. An artificial line giving a resistance drop of 4 per cent and a reactance drop of 1 per cent was placed between the generator and the motor and load. The generator field was so adjusted that the terminal voltage was constant throughout the test. The results are plotted in Fig. 10, which shows that the power-factor correction is practically perfect.



FIGS. 12 AND 13—FORCE TRIANGLE FOR VOLTMETER WITH CONNECTIONS OF FIG. 11; EFFECT ON VOLTMETER FORCE TRIANGLE OF POWER FACTOR CURRENT AND GENERATOR VOLTAGE

Maintaining Industrial-Plant Equipment

The Electrical Apparatus of a Large Ohio Mill Has Been Found to Last for a Longer Period and to Give Less Trouble During Its Life Because of the Fact that an Effort Is Made to Remedy Troubles Before They Become Really Serious

A SURPRISINGLY large number of industrial plants in the United States have grown until their electrical equipment is equal in rating to that required to serve completely a city of 100,000 people. Because of the necessary power houses, substations, transmission and distribution lines, the men who supervise the electrical equipment are confronted with the operating problems common to the central station plus all of the problems of central-station customers.

To illustrate the responsibilities falling on the electrical department of an industrial company a specific case in Ohio will be considered and the methods of handling the problems will be discussed. At this plant is an 18,000-kw. generating station serving various mills within a 1200-acre tract of land about 1.6 miles (1.9 km.) long. The station contains three 3000-kw. gas engines, three 1500-kw. turbines and three 1500-kw. cross-compound steam engines, all driving 6600-volt, 25-cycle, three-phase generators. The plant operates at an annual load factor of 57.6 per cent; the load factor of the gas engines is 87.2 per cent. Four rotary-converter substations and one motor-generator substation located conveniently throughout the area receive the energy and convert it into direct current at 230 volts. The connected motor load, which is equal to 2.82 times the generator capacity, is nearly all supplied with direct current, but the 1550 kw. of lighting equipment will soon all be operated from alternating current. The motors number about 2135 and range in size from 3000 hp. down to fractional-horsepower units. These facts help to show how much equipment there is to maintain.

One of the most important factors in maintaining the equipment of the plant is the organization. Complete responsibility for the production of tonnage and high-quality products is vested in the manager of the works. His immediate subordinates are five in number, composed of four superintendents of manufacturing units and a superintendent of engineering and mechanical departments. Reporting directly to the superintendent of engineering and mechanical departments are the superintendent of the electrical department and the superintendent of shops. It is the former who has direct responsibility for the electrical maintenance in addition to his other duties. These other duties con-

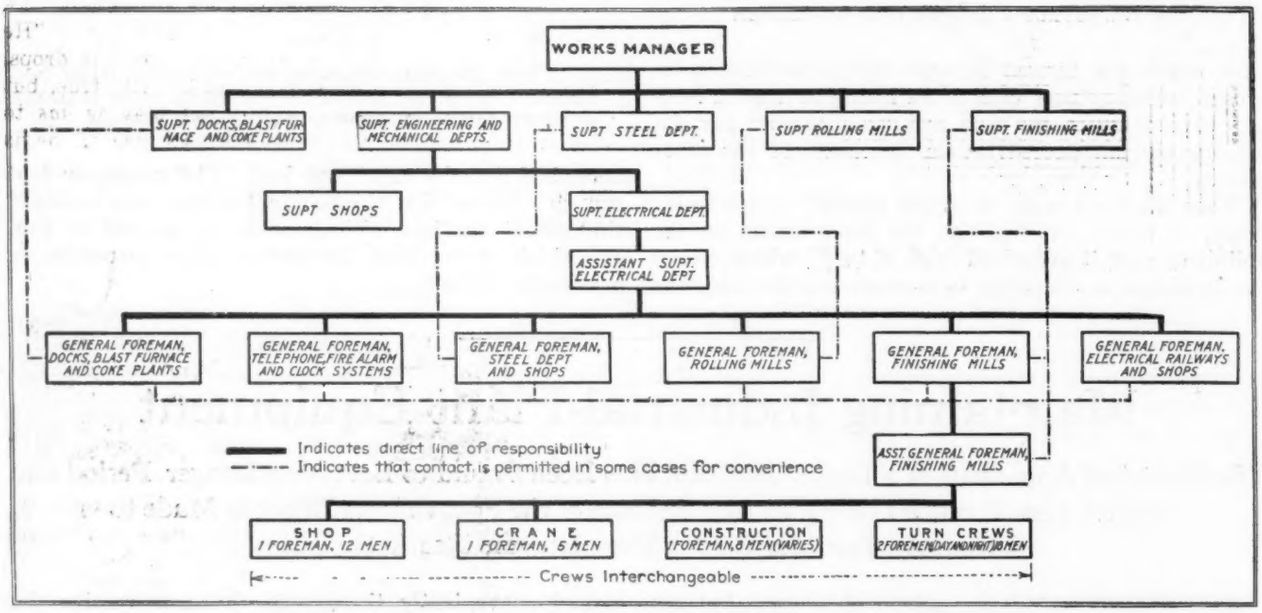
sist of both construction and operation activities. Indorsing designs and general layouts for construction work and supervising the actual installation of large equipment constitute the greater part of his construction work. While the electrical department does all ordinary electrical installation work it does not have an organization of riggers, since these men are supplied by the operating departments. The electrical superintendent's operation activities include passing on rules worked out by the general safety department. The crane operators are not supervised by the electrical department as is the case in some plants. Considered with the organization chart shown herewith, these statements indicate the relation of the electrical department to the mill organization as a whole.

The electrical department consists of about 275 men directed by the superintendent of the electrical department through his assistant and six foremen. The general lines of responsibility are shown on the diagram. From the names given the various foremen it may be observed that the four general foremen are separately responsible for certain physical sections of the plant, as (1) docks, blast furnace and coke plants; (2) steel works, (3) rolling mills, and (4) finishing mills. The other two foremen have charge of special apparatus regardless of location. For convenience and to get the value of direct contact each of the four foremen first named deals directly with the various mill foremen who are in the production departments of his section on problems affecting minor changes and maintenance. The foreman of the electrical repair shops and the foreman of the telephone, fire-alarm and clock systems deal directly with the other electrical foremen and with each other on minor problems. For example, a question of changing a motor in the finishing mill would be settled between the general foreman of finishing mills representing the electrical department and the responsible operating foreman.

Each general foreman has his own organization, that of the general foreman of finishing mills (see diagram) being typical. This general foreman spends a great deal of his time with the general mill foremen and their assistants working out ideas that will assist in improving operating conditions and practice. His assistant is his understudy and follows up all details closely. It is a characteristic of the organization plan that each responsible man is continually training some one to be competent to take his place.

It so happens that the general foreman of the finishing mills is the only one who has a repair shop of his own. However, each of the other general foremen has facilities for making small repairs at his tool and supply room, where he usually has one man in charge. General shop facilities are afforded through the foreman of the electrical repair shop, who in his main shop has a foreman in charge of winding and a total of thirty-six workmen. Of these fifteen are in the winding department and the rest are machinists and bench repairmen.

In the typical organization of the general foreman of finishing mills the crews of the shop foreman, crane foreman, construction foreman and turn foremen are interchangeable on request through the assistant foreman of the finishing mills. Each "turn" foreman, or day and night foreman, has a crew of nine men. These men spend their time around the plant continually, looking for places to prevent trouble before it occurs.


WORKS MANAGER
SUPT. DOCKS, BLAST FURNACE AND COKE PLANTS
SUPT. ENGINEERING AND MECHANICAL DEPTS.
SUPT STEEL DEPT.
SUPT ROLLING MILLS
SUPT. FINISHING MILLS
SUPT SHOPS
SUPT. ELECTRICAL DEPT.
ASSISTANT SUPT. ELECTRICAL DEPT
GENERAL FOREMAN, DOCKS, BLAST FURNACE AND COKE PLANTS
GENERAL FOREMAN, TELEPHONE, FIRE ALARM AND CLOCK SYSTEMS
GENERAL FOREMAN, STEEL DEPT AND SHOPS
GENERAL FOREMAN, ROLLING MILLS
GENERAL FOREMAN, FINISHING MILLS
GENERAL FOREMAN, ELECTRICAL RAILWAYS AND SHOPS
Indicates direct line of responsibility
Indicates that contact is permitted in some cases for convenience
ASST. GENERAL FOREMAN, FINISHING MILLS
SHOP 1 FOREMAN, 12 MEN
CRANE 1 FOREMAN, 5 MEN
CONSTRUCTION 1 FOREMAN, 8 MEN (VARIES)
TURN CREWS 2 FOREMEN (DAY AND NIGHT) 18 MEN
Crews Interchangeable

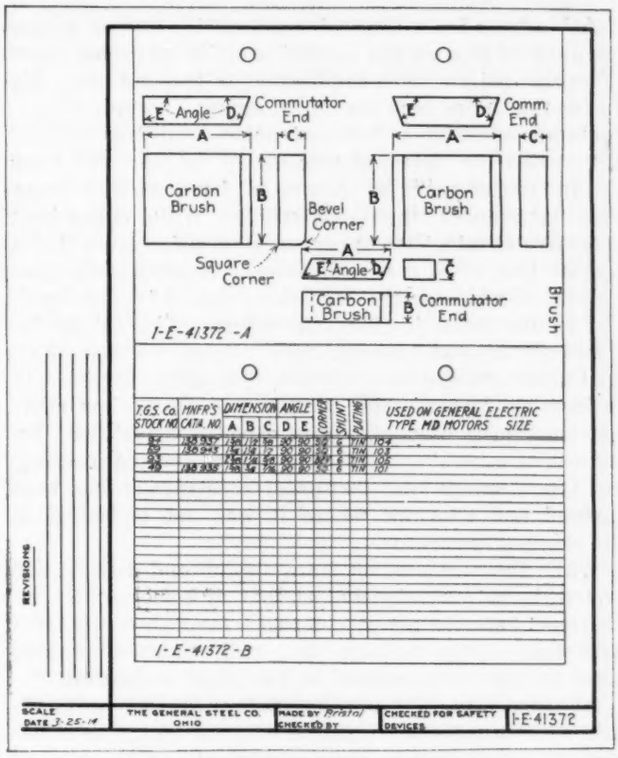
ORGANIZATION CHART SHOWING LINE OF RESPONSIBILITIES FOR ELECTRICAL WORK

TRAINING AND ENCOURAGEMENT FOR THE MEN

The methods employed for training these men are quite interesting. New men hired for the department are just as apt to be former dry-goods clerks as anything else. The majority know little about electricity, so they are first placed in the construction or shop crews as helpers. Here they become accustomed to seeing what can happen to motors and controllers that will make it necessary to bring them into the shop for repairs. They also learn what each piece of apparatus is for and how the trouble that brought it to the shop could have been avoided. For example, if a motor is brought in because it commutates poorly all of the causes of bad commutation are explained to the new men who are to work on it. Rough commutators, improper brush tension, use of wrong brushes, high mica,

neglect of brushes, are all considered and the real cause of the trouble is discovered and corrected.

At the same time, these men are all encouraged to go to the local Y. M. C. A. school, which is taught by an employee of this industrial company. This man is really a specialist on the types of equipment used in the mills. Most of the new men do attend and are



ONE FORM OF RECORD SHEET USED

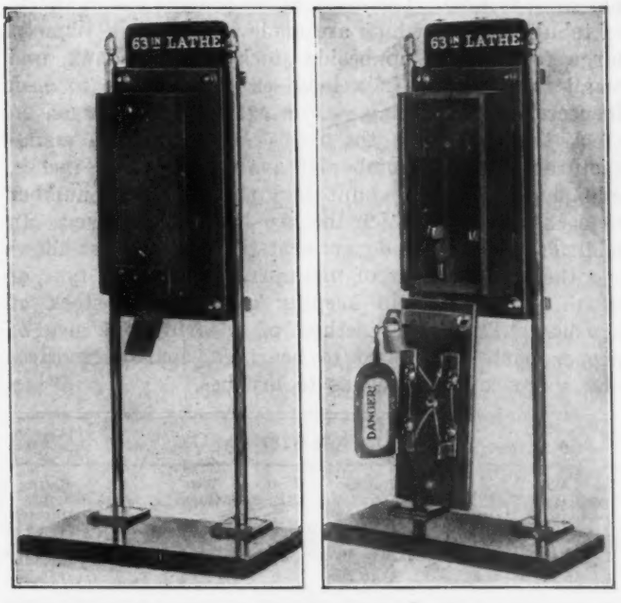
taught how to read blueprints and have opportunities to study existing and new equipment. This combined practical and scholastic educational process goes on continually. Whenever a man is found to have grasped the situation and to have initiative, he is made a motor or a crane inspector. He is then put out in the mill "on his own," where he, of course, has the guidance of his turn foreman. The inspectors oil all motors, which requires that they visit all machines frequently. They know that dirt is the cause of most trouble and hence is their chief enemy. They attempt to keep essential parts clean despite the fact that steel mills are especially dirty. To aid them in this work the company has gone to considerable expense and trouble to make equipment dust-proof. At first there was some question as to the advisability of this preventive, because it was argued that inspectors would neglect to look at housed machinery and that trouble would be detected more quickly on open machines. It is now known that such is not the case. Providing dust-proof electrical machinery has reduced trouble and aided in reducing accidents.

In addition to being trained for maintenance work, the men are encouraged to make suggestions which not only work to their benefit but prolong the life of equipment. So thorough is the belief in this policy that superintendents and foremen are instructed to consider seriously all suggestions from the men, even if they at first doubt the practicability of the suggested idea. There is more back of this policy than a mere desire to please the man who makes the suggestions. The idea may be good and the man may be entirely unable to put it into words. Even if the idea will not work, the company eventually gains because when the suggester has been shown that his idea is impracticable he is encouraged to find a way to remedy the condition which he has said can be improved.

AN IMPROVED SUGGESTION BOX IDEA

The suggestion box system is different from the one ordinarily used. Suggestions are typewritten in duplicate and the originals are dropped in the boxes unsigned. When they are considered by the committee it is impossible for that body to tell whether it is handling an idea of the most skilled employee or of the newest helper in the shops. Each suggestion is considered on its merits. At the end of each six months all accepted suggestions are published in abstract so that the holders of the carbon copies can produce them and claim their awards of $2 to $100 for each idea, depending on the estimated value. This plan helps to fill the suggestion boxes. However, the biggest factor in bringing out ideas that will make equipment last longer is the company's policy of being liberal in trying out ideas.

One of the greatest evils to be guarded against in steel-mill practice is interruption of service. It has been said of the steel-mill electrical engineer: "He buys equipment to run and he runs it until it drops. Then he replaces it." This is almost literally true, but emphasis should be placed on the fact that he *has* to keep it running continuously. For this reason he is equipped with a shop in which to do almost anything in the way of winding. At the plant referred to herein this is particularly important because of the quantities of direct-current motors and control apparatus which cause most of the maintenance work. To get the equip-



FOOL-PROOF INDUSTRIAL SWITCH EMPLOYED IN OHIO INDUSTRIAL PLANT

ment back in operation in the shortest possible time, it has been found advisable to adopt a definite policy as to whether repair parts are to be made on the ground or are to be bought from the electrical manufacturer. Regarding control apparatus it may be said that the electrical department carries a stock of all spare parts except coils, which are wound in the department shops

wherever possible. For motors the electrical department does all field and armature winding in addition to the major part of all other motor repairs.

To assist in making repairs complete carefully prepared data on every piece of electrical apparatus in the mill are kept. When a new piece of control apparatus is bought, for instance, all of the manufacturer's literature on it and each part of it is secured. Catalog numbers and serial numbers of parts are obtained, and if prints of certain parts of it are not available, they are made by the electrical department. This takes time and involves correspondence, but it saves delay and telegrams at some later date when repairs become necessary. This practice is carried out in connection with even such items as contactors on control panels. Having prints of parts available is especially valuable in case it is necessary to make the parts locally. On the whole, the repair-parts policy is designed to solve the problem of slow deliveries and to obviate the necessity of carrying too many repair parts in stock.

A specific plan has been evolved to afford a check on machines which give an extraordinary amount of trouble. Each mill superintendent sends the electrical department daily a record of "delay reports" where interruptions in service are due to failure of electrical apparatus. Such reports immediately call attention to repeated failures if they occur. They also permit the general foremen to get in touch with bad situations which their assistant foremen may have deemed of insufficient consequence to report.

How Fuse and Brush Problems Are Handled

Some parts of equipment require special provisions to assure their proper replacement. Brushes will serve as an example because they are such a great source of potential trouble. The heart of the scheme lies in sheets of tabulated data which are made in two sizes, namely, large for tacking up beside stock-room windows, and small for carrying in a loose-leaf book given to each inspector and foreman. For each type of brush in stock the data give the mill's stock number, manufacturers' catalog number if available, size in inches, end shape, type of shunt and the type and number of each motor on which the brush should be used. In addition to this, the department maintains a list showing the total number of motors using any one type of brush. This aids in keeping an adequate stock of brushes. The same method of insuring the use of proper parts is applied to bearings, spare armatures and spare coils as well as to brushes.

COPPER FUSE WIRE TABLE

Size of Wire B. & S. Gage Nos.	Rating in Amperes	Size of Wire B. & S. Gage Nos.	Rating in Amperes
22	15 to 25	14	71 to 110
19	26 to 40	12	111 to 160
16	41 to 70	10	151 to 300

The fusing situation has also received careful attention. On all circuits carrying from 15 amp. to 300 amp. special fused switches made by the electrical department are installed. One of these switches is shown on page 625. All switches are fused with tinned copper wire except those rated at 25 amp., on which cartridge fuses are employed. The table published here gives the corresponding sizes of fuse wire and ampere ratings.

Turn foremen have specific instructions to watch for cases of overfusing. The fusing is done chiefly by the motor inspectors. In a few special cases where all delay must be avoided small stocks of links cut to proper lengths are given to mill operators. Even in this case the motor inspector is held responsible for overfusing.

Equipment That Is Easy to Maintain

Aside from these ideas on organization and on proper handling of repairs, the careful selection of proper types of equipment for each application is the one other big factor that helps keep the mill running. A study of performance of different types of motors with this in mind has caused the electrical department to get away from the industrial types of motors in favor of mill types. This has reduced trouble materially. While it has been necessary to take time to persuade manufacturers that a special line of shunt, compound and adjustable-speed motors suitable for the conditions should be developed, the results have justified the effort. The totally inclosed motor is also finding favor rapidly because of its dust-proof construction. While it usually is necessary to install a larger motor of this type than when other construction is used, the extra expense is justified. Selections of control equipment have been limited to standard types, except that dirt-proof construction has been favored and provided where it was not embodied in the original apparatus.

While the high-tension transmission and distribution system is not so extensive as that of some similar industries, nevertheless it compares favorably in extent with that of the average steel mill, which is obvious when the territory covered by the plant is recalled.

All important high-tension feeders are run in duplicate with suitable arrangements for switching to either circuit of each pair at the power plant and the various substations. The flexibility obtained by duplication makes continuity of operation, inspection and repairs so easy that no special ideas have been formulated in connection with the maintenance of this part of the electrical equipment. One of the most important phases in the handling of high-tension equipment is the safety of the workmen, and this has probably received more thought and study than any other one thing since the planning of the original layout.

The control of the entire main distribution system is vested in the switchboard operator at the power plant. No work is permitted at any point on the system between the power plant and the bus at substations without a permit from him having first been issued. It is the operator's duty to arrange for all necessary switching and grounding of lines before permission is given to proceed with any work. The entire transaction is made a matter of written record both at the power plant and substations affected by any switching of the circuits. While this procedure is primarily for safety reasons, continuous service is also assured so far as the human element is concerned.

Summary of Procedure

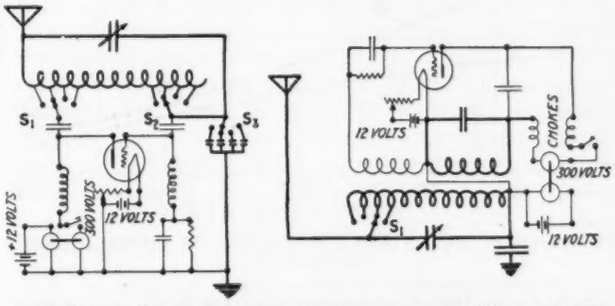
To summarize, the electrical apparatus is made to last longer by providing methods of preventing trouble or of discovering it as soon as it begins to occur. Not a little of the success of the method is attributed to the care given to educating and to organizing the human forces engaged in the work. Collection and dissemination of data on machines and machine parts before they are needed also assist in reducing delays.

Continuous-Wave Land Radio Sets

Present Development in Radio-Telegraphy Points to Great Usefulness of Continuous-Wave Sets on Account of Freedom from Interference—Extremely Sensitive Receivers and Suitable Transmitting Equipment Have Been Produced by the Use of Vacuum Tubes

BY LIEUT. PAUL T. WEEKS AND LIEUT. DONALD G. LITTLE, SIGNAL CORPS, U. S. A.

THE radio sets described in this article were designed to meet very special requirements, yet they may be taken as indicative of what is the probable trend of development in low-power commercial radio sets in the near future. The outstanding features are the use of vacuum tubes for transmitting, the use of a low power transmitter with a sensitive receiver and the elimination of adjustments. It has been demonstrated that this type of continuous-wave set can be made at least as reliable and simple in operation as the usual spark set of equal range. The greatly increased selectivity and freedom from interference that are characteristic of transmission by undamped waves makes its general introduction in place of spark transmission almost imperative if there is to be any considerable extension of radio communication for commercial purposes. The development of vacuum tubes suitable for power oscillators and reliable and interchangeable in operation has provided a very simple and inexpensive form of continuous-wave generator. The development of an extremely sensitive but simple receiver with the consequent reduction in power required at the transmitting end is another step toward the elimination of interference and the possibility of simultaneous operation of a large number of radio sets in close proximity



FIGS. 1 AND 2—TRANSMITTING CIRCUIT WITH (1) CAPACITY COUPLING AND (2) INDUCTIVE COUPLING

and within a narrow range of wave lengths. The material reduction accomplished in the number of adjustments both of transmitter and receiver has largely eliminated the necessity for a highly skilled operator and has made possible a reliability and convenience in operation second only to that obtained with the wire telegraph. These developments, if properly followed up, will be a considerable step toward the wide commercial usefulness of the lower power radio set.

REQUIREMENTS OF THE SERVICE

In considering the requirements of the service the radio network under the conditions existing on the western front may be divided into three sections. First, there is the forward section where operators and apparatus are subjected to the most severe and unfavorable conditions. Extreme portability and simplicity are fundamental requirements for the radio apparatus. Skilled operators cannot be afforded, and the adjustments must be reduced to the absolute minimum. The antenna is limited to a ground line or a waist-high aërial, and power input to the set must be no more than can be supplied by storage batteries which one man can carry. Under these conditions a range of two or three miles (3 km. to 5 km.) has sufficed. Throughout the war radio communication in the forward sector has been exclusively by spark sets of the simplest type, and no consideration need be given here to the possible use of continuous-wave sets for this purpose, although very important developments along this line have been made.

Continuous-wave radio sets have found application particularly in the intermediate and rear sections of the radio network, where much more favorable conditions obtain. Here the apparatus is set up in semi-permanent stations, better operators can be afforded, and a reasonable amount of adjustment and careful manipulation may be required. However, the sets must still be rugged, simple in operation, portable by hand for short distances and capable of being set up quickly. The power input must be limited because of the difficulty of supplying batteries. The antenna must be of low visibility and easily erected and maintained. This latter requirement applies particularly to the intermediate section. For this section a range of 10 to 20 miles (16 km. to 32 km.) is considered sufficient. In the rear section, where larger and more permanent antennas can be utilized, a range of 50 to 100 miles (80 km. to 160 km.) for communication between army headquarters is required.

The work of the Signal Corps in this field of continuous-wave transmission has consequently been limited almost exclusively to the development of vacuum-tube receiving and transmitting equipment, although the latter had been previously used only in a laboratory or experimental way. What at first appears to be a serious fault in any vacuum-tube generator is the low over-all efficiency resulting in large part from the relatively large amount of power required to heat the filament. In spite of the fact, however, that the high-frequency output of a low-power tube is seldom more than 20 per cent of the total input, the vacuum-tube transmitter can be made to approach or even surpass an equivalent spark transmitter in efficiency in miles per watt of input to the set.

VACUUM-TUBE TRANSMITTERS

The Signal Corps development of low-power vacuum-tube transmitters has been based almost entirely on the standard Signal Corps tube known as type VT-2. This requires a filament current of 1.36 amp. at 7 volts and with a plate potential of 300 volts to 350 volts will give a high-frequency output of 3 watts or 4 watts in a suitable circuit. This tube was first used in radio-telephone sets. Shortly following its development the first Signal Corps vacuum-tube telegraph transmitter was designed.

It employed an inductively coupled type of circuit with one transmitting tube and was used entirely for instruction purposes. In the meantime the requirements of the service for rear and intermediate communication became more exactly known, and to meet these there were developed the two-way vacuum tube sets of the type represented by the SCR-79 set, which combine to a considerable degree the required characteristics of ruggedness, portability, few and simple adjustments and ability to operate over a variety of wave lengths and on antennas characterized by high resistance and having various capacities.

DETAILS OF TRANSMITTING CIRCUITS

The transmitting circuit of the SCR-79 set, shown schematically in Fig. 1, is of the capacity-coupled type. Very satisfactory results had been obtained from this type of circuit in radio-telephone transmitters, and it had proved to be reliable and efficient in operation over a wide range of antenna constants and to require only simple and non-critical adjustments. It is essentially simple, containing only the single oscillating circuit made up of the antenna, transmitting inductance coil and series condenser. Capacity coupling is used, the alternating grid input voltage being obtained from the reactive drop across the series condenser, and the voltage developed in the plate circuit is in effect applied directly to the antenna. Only the one large inductance is required, and the circuit oscillates readily. The three tuning adjustments are indicated in Fig. 1. S_1 is the wave-length adjustment. S_2 is the plate coupling adjustment which is required to give maximum power output. S_3, controlling the input voltage, is necessary

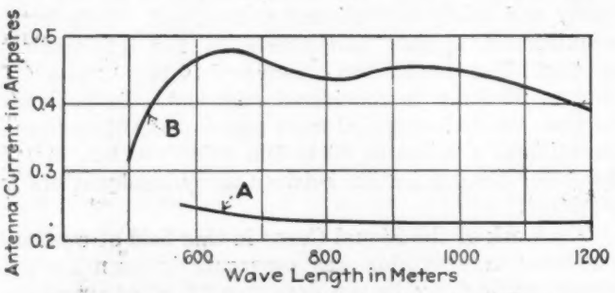


FIG. 3—WAVE-LENGTH CHARACTERISTICS OF ANTENNA CIRCUIT

A—Capacity coupling: C = 300 mmf.; R = 70 ohms; E = volts.
B—Inductive coupling

to avoid overloading the tube. It is evident that these adjustments are not entirely independent. In the actual set the positions of the inductance taps and the values of the input condensers have been so chosen that the three switches are operated by a single handle without the necessity of individual adjustment of the plate coupling and grid input. The fact that this arrangement secures nearly enough maximum output and prevents overloading the tubes over the wide range of wave lengths and antenna resistances and capacities encountered is evidence both of careful design and of the suitability of this circuit for the purpose. Other details of the circuit may be considered as minor but are essential to proper operation. The plate and grid are insulated from the antenna by blocking condensers. To supply the direct current to the plate without short-circuiting the antenna for high-frequency current, the choke coil is introduced into the plate lead. The high-frequency choke and resistance in the grid lead perform a similar function. The by-pass condenser around this resistance is not essential, and even the choke coil could be replaced by added resistance. This resistance in the grid lead, together with the grid current, performs the added function of producing the negative potential on the grid which is necessary for efficient operation and to prevent overheating the tube. The small variable air condenser which parallels the inductance coil is provided to make the wave-length range continuous. A positive plate potential of 300 volts to 350 volts is supplied by a dynamotor operated from a 12-volt storage battery. In the actual set two transmitting tubes are used, their filaments, plates and grids respectively being connected in parallel. Their filaments are lighted by the same storage battery that operates the dynamotor. To secure proper filament current throughout the discharge range of battery voltage, a filament rheostat is provided. The variation of current output with wave length under the unfavorable conditions of low antenna capacity and high antenna resistance is shown in Fig. 3A. Fig 4A shows the variation of output current with antenna resistance when operating with an antenna of approximately average capacity.

The antenna current is much smaller than would be required from a spark set of equal range, but is more than sufficient to give the required range of 20 miles (30 km.). It is seen that, while the transmitter has a low over-all efficiency, it meets the requirement of fairly uniform output over a wide range of wave lengths and antenna constants.

An inductively coupled type of transmitting circuit employed in the early instruction set was found to pos-

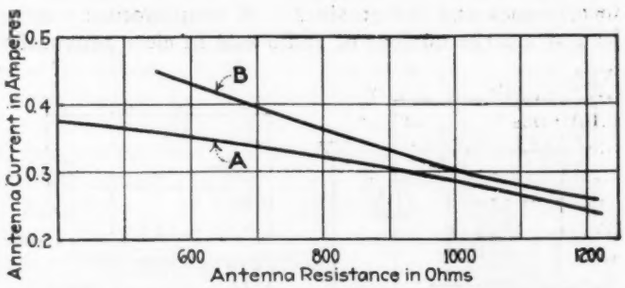


FIG. 4—EFFECT OF ANTENNA RESISTANCE ON CHARACTERISTICS OF CIRCUIT

A—Capacity coupling: C = 400 mmf.; λ = 630 m.; E = 300 volts. B—Inductive coupling: C = 450 mmf.; λ = 600 m.; E = 300-340 volts.

sess some valuable features in the way of simplicity of adjustments, and further experimental work led to its substitution for the capacity-coupled circuit in the later models of the SCR-79 set. It is shown schematically in Fig. 2. It will be noted that the input couplings in the grid circuit and the output coupling in the plate circuit are both entirely inductive. The plate coupling coil with the condenser bridged across it forms a reasonant circuit of natural period slightly less than the period of the shortest wave length to which the antenna circuit can be tuned. The coupling is such, however, that this circuit is forced to oscillate at the same frequency as the antenna circuit. The outstanding advantage lies in the fact that if the coils are properly designed, there is required no mechanical change of coupling for different wave lengths and the only tuning adjustments necessary are the antenna inductance switch S_1 and the small variable air condenser, which parallels the antenna and makes the wave-length range continuous.

The design of the inductance coils, which, while fixed in position, will give the proper coupling over a wide range of wave lengths and antenna constants, required some careful experimental work. The other details of the circuit are similar to those of the earlier circuit. A negative grid potential is obtained by means of a grid condenser and leak. The plate potential is supplied by a dynamotor, which is isolated from the high-frequency oscillations by choke coils. The actual set employs two tubes in parallel as in the previous model. The variation of output with wave length when operating on an actual antenna of standard form is shown in Fig. 3B, and the variation of output with antenna resistance in Fig. 4B. It will be noted that the output is somewhat greater than obtained with the capacity-coupled circuit.

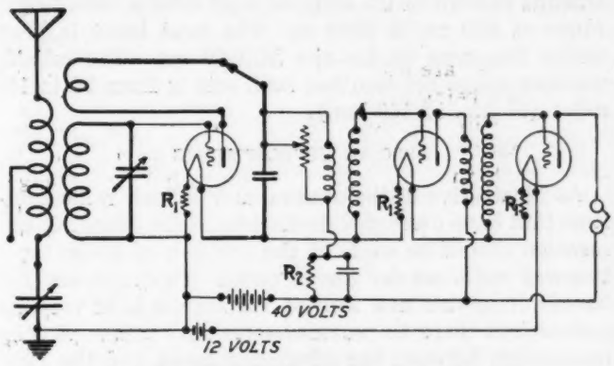


FIG. 5—RECEIVING CIRCUIT OF SCR-79 SET

VACUUM-TUBE RECEIVERS

The employment of vacuum tubes in receiving both damped and spark signals had become very common before the war, and to a much more limited extent this applied also to low-frequency vacuum-tube amplifiers. Great sensitivity was frequently obtained, but the characteristics of the circuits and tubes commonly used were such as to make the successful handling of a sensitive vacuum-tube receiver an art. Aside from the careful tuning of the radio circuits there was required in general the careful individual adjustment of grid, plate and filament potentials of each tube in the set. A receiver of this type was out of the question for field service that was necessarily in the hands of unskilled operators.

The most important part of the problem was solved with the development of a high vacuum tube sufficiently uniform in characteristics and non-critical in adjustment to operate interchangeably under fixed conditions and without being materially affected by small changes in grid, plate and filament potentials. The standard Signal Corps tubes, type VT-1, have been found to give the best results, but other types have been developed which will operate successfully in the same circuit, though with decreased sensitivity in general.

The receiving circuit of the SCR-79 set in effect combines a vacuum-tube detector and heterodyne with a two-stage amplifier. The circuit is shown schematically in Fig. 5. The radio circuit is of a familiar feed-back type, having a tuned grid circuit and a tickler coil connected in the plate lead. The unique feature is the design of the primary, secondary and tickler coils. These are wound on separate forms but are fixed in such relative positions that there is required no adjustment of the coupling either between the primary and secondary or the secondary anl tickler coils over the entire range of wave lengths. For short waves only a part of the primary coil is used. The only other tuning adjustments are the manipulation of the primary and secondary variable air condensers, and the reception of continuous waves is made simpler even than the reception of damped waves by the ordinary coupled receiver. A single-pole switch enables the tickler coil to be cut out for receiving spark signals. The notable features of the amplifier are the absence of all tube adjustments and the use of the specially designed and highly efficient inter-tube transformers. Control of the amplitude of the signals is obtained by the variable resistance which shunts the primary of the first transformer. This, with the sharp selectivity of the heterodyne receiver, permits the elimination of all but exceptional interference.

The negative grid potential to give the best operation of the tubes is secured by the drop in potential in the series resistances, R_1, in the filament circuit. The use of the large resistance R_2 in the plate lead of the detector tube to reduce the plate voltage to a more suitable value for operation of the detector tube has the advantage of insuring a sufficiently high initial voltage to start the oscillations. The plate voltage is supplied by two fifteen-cell miniature dry-battery units that weigh only about 1 lb. (0.5 kg.) apiece and have sufficient capacity to give continuous operation for several weeks.

THE COMPLETE SET

The transmitting and receiving circuits are combined in the set box shown in Fig. 6. The two circuits are entirely separate except that they employ the same filament battery and antenna. Hence they can be tuned entirely separately and the complete change from transmitting on one wave length to receiving on the same or a different wave length can be made by throwing a single switch. The adjustments are the same externally for the sets employing the capacitively and the inductively coupled transmitting circuits. The transmitter is set for the approximate wave length by the wave-length switch and the fine adjustment made with the condenser. The filament rheostat gives control of the filament current. In tuning the receiver the two two-position switches are first set at short or long waves and heterodyne or spark as required. The tuning is then done entirely by the primary and secondary condensers. The amplification switch is operated to reduce the signal strength and to cut out interference. Provision is made for clamping the variable condensers in any position to secure the constancy of wave length and tuning required for heterodyne reception.

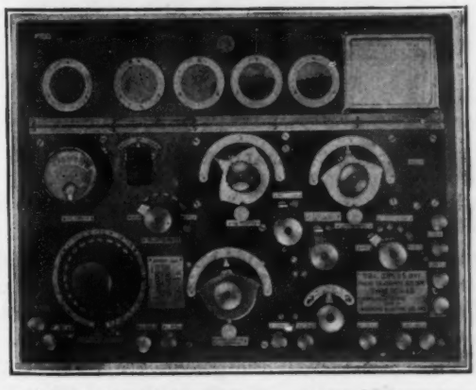


FIG. 6—TWO-WAY CONTINUOUS-WAVE RADIO SET

Wave lengths are determined by means of a special wave meter carried in the same carrying case as the set box. This wave meter consists of a fixed condenser and variable inductance, and while in over-all dimensions it is approximately only a 5-in. (12.7-cm.) cube, it covers the wave length range of 500 m. to 1100 m. with an accuracy of 1 or 2 per cent. It contains a buzzer for setting the receiving circuit and a miniature incandescent lamp for indicating the resonance point when measuring the transmitted wave length. By reason of this last feature it obviously operates as well with undamped as with damped waves.

The dynamotor which supplies the plate voltage for the transmitter represents what has proved the best solution for a problem which had previously offered serious difficulties in the design of continuous-wave sets for service at the front. It has what would normally be called a low electrical efficiency, but is particularly valuable because of its reliability and light weight. The dynamotor proper is less than 5 in. (12.7 cm.) in diameter by 9 in. (23 cm.) long and weighs 15 lb. (7 kg.). With its water-tight aluminum carrying case it weighs about 25 lb. (11 kg.). Its early and successful production was made possible by the advanced state of development of the automobile starting motor, of which it is a modification.

Design of the Storage Batteries

The storage batteries supplied with the set were designed particularly for the service, especial attention being paid to light weight and ease of repair. They consist of 4-volt, 100 amp.-hr. units which have an

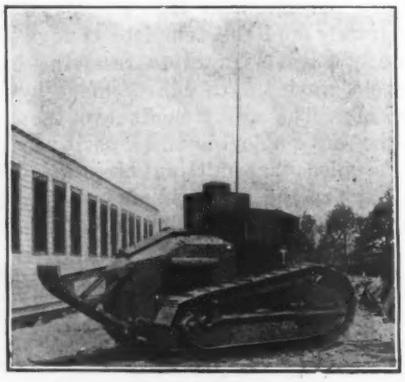


FIG. 7—SMALL SIGNAL TANK

over-all volume of about 1000 cu.in. (16,000 cu.cm.) and weigh less than 40 lb. (18 kg.). An unusual feature is that the separate cells are removable, and those made by some manufacturers have transparent celluloid containers so that the internal condition of the cell can be determined by inspection.

The set when transmitting draws a total of 10 amp. or 12 amp. from the 12-volt battery. The input to the plate circuit is about 30 watts and the high-frequency power delivered to the antenna 5 watts or 6 watts. When receiving a battery current of only a little over 1 amp. is required. The standard antenna is 20 ft. (6.1 m.) high and consists of two 100-ft. (30.5-m.) branches making an angle of 60 deg. with each other. With this antenna the working range between two sets is easily 20 miles (32 km.). The set box, dynamotor, wavemeter and other accessories are contained in a carrying case weighing, complete, a little over 100 lb. (45 kg.). The antenna and ground material weighs complete about the same and is arranged in convenient carrying units. Light bamboo or spruce masts are employed.

For communication over somewhat longer distances and at longer wave lengths a set very similar to the latter model of the SCR-79 set has been developed. This is designed for an antenna of similar form but longer and having larger capacity and lower resistance. With an antenna resistance of not over 30 ohms it gives an antenna current of 0.5 amp. or more over a wave length range of 900 m. to 1900 m. The total input is practically the same as for the SCR-79 set. The reliable working range between two such sets is from 50 to 100 miles (80 km. to 160 km.).

Special Developments

As illustrative of the unusual and difficult radio problems that have presented themselves to the Signal Corps, mention should be made of the problem of designing a two-way radio set for use in tanks. To derive the full benefit from this new arm of the service it is very essential that there be provided some sure means of communication between the advancing tanks and the rear. Experience has abundantly proved that the ordinary means of communication by pigeon, runner or visual signaling are insufficient for this purpose, and resort was had to radio. The inherent difficulties are obvious when it is considered that the antenna must be extremely small and inconspicuous, that operation with the tank in motion is necessary, and that a very loud signal is required on account of the extreme noise within the tank. The fact that the existent radio network necessitated the use of undamped waves only added to the difficulties.

The solution was found in a vacuum-tube set combining a receiving circuit similar to that of the SCR-79 set with a transmitter which was somewhat more powerful.

A transmitter of rather unusual design was required to insure the necessary constancy of emitted wave length, regardless of the motion of the tank, and also to give sufficient antenna current. The necessity for an unusually high antenna voltage is evident when it is considered that the capacity of the antenna is about 60 micro-microfarads as compared with the 400 to 500 micro-microfarads capacity of the antenna of the SCR-79 set. The design of this antenna was no small part of the problem. Two forms are provided, one a jointed fishpole type about 15 ft. (4.6 m.) high and the other an umbrella type about 3 ft. (0.9 m.) high with self-supporting folding arms. Both are arranged to be erected easily from within the tank. An antenna current of about 0.3 amp. is obtained giving a working range of 5 miles (8 km.). The appearance of a small signal tank with special turret and antenna is shown in Fig. 7.

An entirely distinct line of development is represented in the tractor set developed for the Signal Corps for comparatively long-distance work. The notable feature of this set is the employment of a number of high-power General Electric tubes operating at a plate potential of 1500 volts to 2000 volts and giving a high-frequency output of about 200 watts per tube at a high over-all efficiency. While entirely portable and self-contained, this set is designed to have a reliable working range of not less than 200 miles (320 km.)

A New Era in Power Transmission

Development of Water Power, Establishment of Stations at Mines and Wider Interconnections Necessary for Proper Industrial Development of the Country and for the Social Betterment of Labor.

BY DR. LOUIS BELL

THE close of the world war is ushering in a period which we shall find to differ radically from anything which has immediately preceded it. The convulsion has been so profound in stirring the very roots of human things that we cannot expect anything like settling back in the old lines for many a year to come, if ever. There will be determined and frantic efforts of reactionaries to undo the material and spiritual work of the great revolution in world affairs, but one might as well attempt to stop the sweep of a comet. The old times, however much lamented by those who dwell in the past rather than in the future, will not come back, and it is the part of wisdom to recognize the changes and to take advantage of them instead of wasting energy in trying to turn their course backward.

RADICAL CHANGE IN SITUATION

One of the things which particularly impress the writer is the radical change in the economic situation as regards furnishing the world's supply of power. We find to-day a very serious increase in the cost of labor and consequently a correlated increase in the cost of producing and transporting fuel. We do not stand face to face yet with the rising prices that come from a real shortage of the material, but the factors of labor and transportation—on the whole the dominant ones—are likely to make a permanent change, especially formidable in the case of the relatively low-grade fuels upon which we have more and more to depend. There is, therefore, a greatly increased advantage in the transmission of energy by electricity, as well as by piped gas, as against the transportation of the fuel and its use locally for producing heat and power. Whether by land or by sea the cost of carriage is likely to give permanent advantage to such methods of transportation, in which the labor item as a continuing expense is minimized.

The arguments in favor of transmitted power are driven home by this condition with altogether unwonted force. What are we going to do about it? The water-power bill, near to its passage when Congress adjourned, is held up, and the first step toward the logical development of power for American industries is to pass that bill at the earliest possible moment and bring into play all the available water powers of the country as soon thereafter as may be. At present prices of fuel we need them all without delay.

This, however, is not the whole story; because in examining the economics of the situation the one factor which stands out with startling distinctness is that, under present conditions, a very large amount of hydraulic power cannot be utilized on account of location and cost of development at a figure which will enable it to compete successfully with steam-driven plants at the mine's mouth. The industrial development of the country requires the coöperation of both in the largest possible measure and such legislation as will enable this coöperation to be made effective. As things now stand a state is at liberty to pass laws forbidding the export of hydroelectric power beyond its limits. Whether it could in a similar way interfere with the export of power derived from coal is perhaps a somewhat different question. In either case the policy is a very short-sighted one in view of existing conditions as respects the transmission of power.

The whole secret of efficient and economical development of the power resources of any territory lies in their combined use by physical interlinkage of the transmission systems, and this is especially true of the general case in which hydraulic and steam power must be used together in order to utilize each in the most efficient way. There are many big networks already operated in this country, and in every instance to good advantage, but there are still far more opportunities than there are networks. The diversity factor which comes into play even from block to block in city distribution is vastly more important when one considers a territory covering thousands of square miles. Then the opportunities for carrying increased load and operating the various generating stations efficiently increase with prodigious rapidity.

It is only the overcautions and ultra-conservative who are inclined to fear the results of interconnection on a large scale. As the readers of this paper well know, the government has already taken in hand the problem of linkage mains. To what extent it can take over work of this kind, either legally or with strategic advantage, remains to be seen, but the principle, by whomsoever carried out, is a thoroughly good one. If, as some among informed engineers hold, there is adequate economic reason for the electrification of a large part of the present steam railways, great interlinked networks to supply the power become a necessity, since their existence solves the problems of shifting load and low average load factor which are so serious in case of the electrification of a long through line. The writer has been hammering away at this question of railway electrification since the very early days of the electric railway, when the operation of a 500-mile line by electric power seemed little more than an iridescent dream. The difficulties of supply at a good load factor over so great a distance have remained formidable almost until the present, but, given the existence of interlinked systems for general distribution over the whole area concerned, the serious difficulties disappear.

NETWORK FROM SEABOARD TO MISSISSIPPI

There is already a network extending practically from the seaboard to the Mississippi—over a small extent of latitude, it is true, but still capable of being reinforced by mouth-of-the-mine plants at a dozen different points and by hydroelectric plants at as many more. Given such a linkage of lines as this would imply, the operation of a long railway system becomes relatively easy, for the moving localized loads, instead of having to be supplied by one or a few stations correlated with the

distance covered, would then merely become floating loads on a system already continuous and supplied from numerous points.

Even this, however, is not the strongest argument in favor of rapid increase of the country's power transmission facilities. As things stand to-day, labor is the dominant factor in industry. Wages have increased to an extent heretofore unknown, and while they will fluctuate, they are not likely to drop to their former level. The eight-hour day is substantially an accomplished fact, and there is little chance that the nine-hour or ten-hour, let alone the eleven-hour or twelve-hour, day will ever come back, at least in the lifetime of the present generation. Now, to make short hours and high wages fit in with a scheme of generalized and successful industry requires the coöperation of high efficiency in production, stability of employment and the good living conditions which make both for efficiency and continuity of work. With a well-nigh universal supply of cheap power, such as can be attained by a thoroughly worked out system of power transmission and distribution, the average effectiveness of labor is greatly increased, as experience has already shown. And it is labor effective, and consequently well paid, that is the source both of continuity of employment and of the living conditions which we all wish to see.

STARTLING SIZE OF LABOR TURNOVER

The turnover in the laboring force of many American industries is something absolutely startling, and continuity of employment, even for those who do not shift about, leaves very much to be desired. If one figures out the actual time of employment per workman per year, it will in many cases be found to be far less than a normal year's work. Steadygoing, efficiently managed industries are necessary to a generally prosperous condition, and the single factor of cheap power supply is here, as elsewhere, extremely important. More than this, it means the possibility of establishing and maintaining successful works without crowding them into regions already crowded, on the hypothesis that they are "good labor markets." A "good labor market" too frequently means a place where many laborers, good and bad, steady and shiftless, have drifted, with the result of finding on the whole unstable employment, low wages and bad living conditions, and such artificially constituted places have not infrequently been evolved around what were then supposed to be locally advantageous points for the supply of power, even though far removed both from the necessary raw materials and from markets.

The "good labor market" is oftentimes really a poor place both for the manufacturer and for the workman. For the former the conditions mean a large turnover in workmen, many men temporarily out of employment, a large influx of the shiftless and ignorant, and perennial labor troubles. For the workman the conditions are bad because the ordinary manufacturer does not realize the losses he incurs through rapid turnover of labor, and because there is therefore constant competition from the shiftless floater, whose presence in increasing numbers also tends to make the general living conditions objectionable. Any force that can encourage the development of manufacturing in localities where workmen will be attracted by good living conditions and where market and raw material are not too distant is one which, on the whole, will tend to better and more stable conditions, likely in the long run to lead to successful developments.

It is this great equalizing capacity of a general and cheap power supply which must be looked to for remedies against some of our most trying social problems. A community under the influence of a well-organized local industry may grow into a very considerable manufacturing center, and that the effect on the workman is beneficent is attested by the comparative rarity of labor difficulties as compared with those found in the congested districts in which manufacturing has, to an extent far too great, tended to collect. One of the biggest things that can be done through the agency of a generalized power distribution is the spreading of industry over far wider territory than at present, bringing with it a higher average degree of prosperity, very much improved permanence of labor and betterment of living conditions. These are things which cannot at the present time be lightly put aside on the theory that things as they are are well enough. For economic and social reasons then, quite aside from purely engineering considerations, the work of developing the power resources of the country ought just now to be pushed with all possible energy by encouraging the development of hydraulic power, the establishment of mouth-of-the-mine plants and their interlinkage to form a reliable general source of energy both for manufacture and transportation.

OUTPUT OF THE LARGEST GENERATING SYSTEMS

Forty-six Companies in the United States and Canada Approximate 25,000,000,000 Kw.-hr., More than Half Developed by Water Power

On the opposite page appear the usual data on the output of the largest generating systems of America. All electric generating companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr. are included. Making an estimate for the output of the Southern Power Company (data on which are lacking), the combined output of the forty-six companies listed is more than 25,000,000,000 kw.-hr., of which 4,500,000,000 kw.-hr. represents the output of companies in Canada—namely, the Ontario Power Company, the Shawinigan Water & Power Company, the Montreal Light, Heat & Power Company and the Toronto Power Company.

Although there was a serious dearth of water both in the Far Western States and in the Southeastern States, so that the ratio of output from water power and from steam power is not so great as it was last year, still more than half of the energy produced was generated in hydroelectric plants. Owing to the consolidation of the Niagara Falls Power Company, the Hydraulic Power Company and the Cliff Electrical & Distributing Company, the present Niagara Falls Power Company tops the list with an output of more than 2,000,000,000 kw.-hr. A most remarkable condition existed on the Niagara frontier, where during the year every bit of hydraulic equipment and of steam equipment was pressed into service because of the great demands for energy both in Canada and in the Niagara and Buffalo districts. For convenience, the statistics for the years 1917 and 1916 are included. The increase in output for 1918 approximates 4,000,000,000 kw-hr.

DATA ON OUTPUT AND LOAD FACTOR OF LARGEST GENERATING SYSTEMS IN AMERICA

(This includes all companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr.)

System	1918				1917				1916			
	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)
Niagara Falls Power Company	254,139	Apr. 8	2,054,360,080	92.2	152,340	Aug. 1	1,188,221,770	88.97	143,360	Nov. 24	1,015,525,680	80.64
Ontario Power Company	224,000	Dec. 13	1,606,786,936	81.9	123,500	Nov. 11	990,086,100	91.5	123,900	Oct. 12	942,221,900	86.80
Commonwealth Edison Company	400,010	Dec. 2	1,508,070,000	43.5	392,330	Dec. 28	1,488,080,000	44.6	369,740	Dec. 19	1,341,964,000	43.20
Montana Power Company	157,800	Nov. 21	1,108,125,350	....	147,712	Jan. 11	947,732,014	73.0	149,740	Dec. 19	867,940,326	84.50
Shawinigan Water & Power Company	136,800	Sept. 24	1,058,136,117	....	119,000	Dec. 21	633,573,610	60.4	108,000	Dec. 14	478,540,000	50.00
Montreal Light, Heat & Power Company	166,730	Dec. 6	976,462,529	68.0	152,665	Nov. 12	946,832,817	70.8	.....	.....	.....	.....
New York Edison Company and United Electric Light & Power Company	286,103	Dec. 11	958,878,156	38.2	278,097	Dec. 12	954,913,584	39.2	254,824	Dec. 20	856,385,319	38.30
Pacific Gas & Electric Company	166,705	June 4	922,037,604	63.1	158,272	Nov. 27	854,099,030	61.6	141,008	Dec. 19	768,304,907	62.20
Toronto Power Company	125,000	Dec. 3	897,512,877	81.9	118,000	Dec. 14	800,638,000	84.0	129,000	Dec. 20	660,873,579	58.40
Public Service Electric Company	185,738	Dec. 5	795,481,279	48.9	181,500	Nov. 27	734,665,649	46.2	174,000	Dec. 14	608,018,729	39.82
Detroit Edison Company	172,000	Dec. 13	773,876,700	51.3	152,300	Nov. 27	672,200,600	50.4	130,200	Dec. 19	546,925,300	47.80
Southern California Edison Company	163,125	July 12	779,758,000	54.5	166,755	Oct. 11	685,416,000	54.4	60,930	Dec. 28	299,950,513	56.04
Philadelphia Electric Company	166,294	Dec. 6	693,447,962	47.6	148,931	Nov. 20	600,583,589	46.0	142,260	Dec. 12	444,785,884	35.60
Duquesne Light Company	141,000	Dec. 6	641,874,585	51.9	125,000	Nov. 9	592,575,925	54.0	101,000	Dec. 21	463,537,660	52.30
Buffalo General Electric Company	104,100	Nov. 22	587,761,870	64.4	95,400	Dec. 6	440,596,100	52.7	65,500	Dec. 14	328,412,550	57.00
Mississippi River Power Company	102,950	Mar. 8	557,200,000	61.8	86,400	Oct. 31	476,500,000	63.0	82,400	Nov. 27	393,400,000	54.30
Cleveland Electric Illuminating Company	128,319	Nov. 22	543,663,042	48.33	113,228	Nov. 27	444,735,309	45.0	84,999	Oct. 25	340,670,721	45.80
Utah Power & Light Company	81,313	Dec. 27	533,044,000	74.83	79,011	Dec. 21	502,183,000	72.5	68,894	Dec. 6	412,726,000	67.80
Tennessee Power Company	87,800	Dec. 11	519,959,383	67.6	85,200	June 15	547,945,475	73.41	81,650	Dec. 14	483,354,162	67.00
Pennsylvania Water & Power Company	89,000	Feb. ..	500,641,122	64.2	86,000	.....	516,891,000	68.6	77,000	.....	417,837,600	61.80
Great Western Power Company	75,480	Aug. 12	451,309,000	68.0	74,900	Oct. 6	457,998,635	71.13	74,100	Dec. 14	408,391,067	62.65
Consolidated Gas, Elect. Lt. & Pr. Co., Baltimore	82,760	Nov. 7	433,196,550	64.9	69,980	Dec. 4	343,523,580	62.4	55,620	Dec. 11	249,836,310	59.10
Puget Sound Traction, Light & Power Company	88,230	Dec. 20	427,800,000	55.4	83,800	Dec. 21	396,600,000	54.0	77,030	Nov. 28	353,697,263	51.80
Consumers' Power Company	98,666	Nov. 21	404,412,000	46.8	94,235	.....	380,570,917	46.0	.....	.....	315,964,337	.....
Electric Company of Missouri and Union Electric Light & Power Company	92,000	Nov. 26	395,820,236	49.1	92,300	Dec. 6	376,891,756	46.5	88,544	Dec. 11	333,964,652	43.10
Alabama Power Company	86,850	Dec. 19	392,247,862	51.5	58,250	Nov. 14	289,715,125	56.7	40,500	Dec. 11	184,345,360	51.07
Wisconsin Edison Company and Milwaukee Electric Railway & Light Company	87,855	Nov. 20	327,784,516	43.0	71,106	Nov. 30	275,966,740	44.0	64,170	Dec. 5	218,421,711	39.00
New England Power Company	76,900	Dec. 16	323,127,784	48.0	71,500	Oct. 30	300,600,000	48.0	64,000	Dec. 12	246,000,000	44.00
Minneapolis General Electric Company	66,189	Nov. 1	297,443,050	53.3	54,940	Dec. 6	222,146,210	46.16	43,640	Dec. 14	171,672,890	44.90
Edison Electric Illuminating Company of Boston	95,774	Dec. 6	293,966,604	35.0	83,966	Dec. 19	265,430,474	36.1	80,539	Dec. 12	239,557,144	33.72
Brooklyn Edison Company, Inc	86,000	Dec. 11	282,424,822	37.5	78,000	Dec. 19	255,912,300	37.5	67,200	Dec. 19	233,452,500	38.10
Portland Railway, Light & Power Company	56,900	Dec. 23	258,424,940	52.0	50,620	Dec. 31	218,086,315	49.0	47,335	Nov. 29	194,146,555	46.50
Sierra & San Francisco Power Company	52,634	July 16	246,759,842	53.7	45,270	Jan. 11	196,069,588	49.44	.....	.....	191,620,000	.....
Georgia Railway & Power Company	68,000	Nov. 8	238,489,012	....	78,200	Apr. 24	258,607,882	.....	72,600	Mar. 17	211,872,638	.....
Michigan Northern Power Company	33,519	Dec. 24	233,381,654	79.4	32,990	Dec. 3	221,538,757	76.7	20,066	Dec. 25	131,075,152	74.40
Rochester Railway & Light Company	52,300	Nov. 22	196,171,300	42.8	42,154	Dec. 13	162,490,264	44.0	40,250	Dec. 16	146,069,428	41.00
Washington Water Power Company	33,956	Nov. 26	195,628,500	65.1	36,707	Dec. 20	188,311,100	58.5	30,440	Dec. 14	162,825,400	60.80
Great Northern Power Company	45,780	....	180,040,171	44.9	40,000	Oct. 24	180,583,920	51.5	38,200	Nov. 21	163,807,560	48.80
Adirondack Electric Power Company	50,250	Nov. 8 & Jan. 23	174,567,275	39.6	42,000	Dec. 7 & 14	158,570,164	43.1	41,575	Dec. 12 & 22	151,128,310	41.40
Potomac Electric Power Company	48,000	Dec. 20	173,180,014	41.0	44,800	.....	140,762,646	36.09	38,600	Dec. 18	122,158,818	36.10
Virginia Railway & Power Company	35,700	Dec. 18	164,810,750	52.8	37,000	Dec. 18	153,128,026	47.39	33,900	Dec. 18	132,275,000	44.54
Southern Sierras Power Company and Nevada-California Power Company	28,200	Aug. 6	161,347,690	65.3	25,900	Aug. 9	148,267,885	65.3	22,400	Apr. 28	131,084,265	66.50
Toledo Railway & Light Company	40,305	Dec. 4	161,103,970	45.7	37,627	Dec.	162,061,232	49.4	36,428	Dec. 22	134,842,360	42.20
Southwestern Power & Light Company	38,100	Sept. 26	148,562,000	44.5	31,500	Nov. 17	126,396,800	46.0	25,600	Oct. 5	95,740,000	43.00
Empire District Electric Company	25,400	Sept. 5	114,446,685	51.4	23,000	Apr. 1	105,487,860	52.4	26,900	Mar. 26	119,280,363	49.70
Southern Power Company *	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....

* No data received.

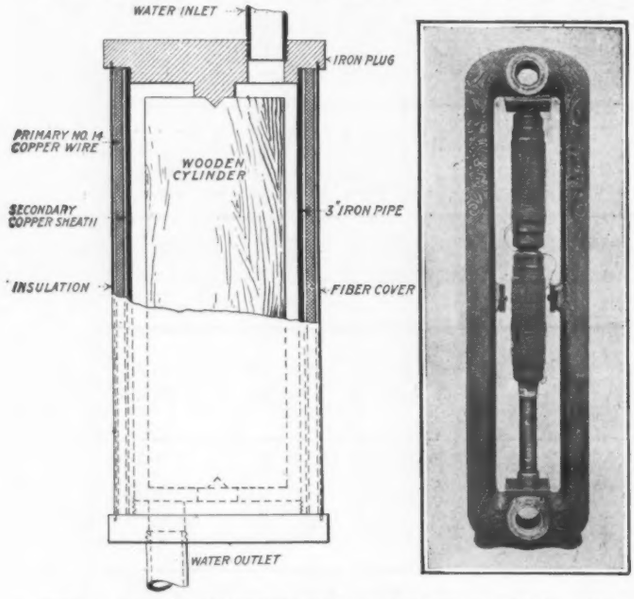
HIGH-POWER-FACTOR INDUCTION HEATERS

Construction and Performance of Three Types Which Are Respectively Suitable for Tank, House and Tap-Water Heating

BY C. EDWARD MAGNUSSON
University of Washington, Seattle

SEVERAL types of induction heaters have been on the market for a number of years, but their use has been limited, mainly on account of two undesirable features—low power factor and the humming sound produced. The handicap of an 80 per cent or even lower power factor, as is the case in many induction heaters, has proved too great for successful competition with resistor type having unity power factor at all loads. Moreover, the alternating flux produced vibrations giving a disagreeable humming sound, which practically excluded this type of heater from residences and other places where noises would be objectionable.

By a new means (U. S. patent No. 1,260,564) there



FIGS. 1 AND 2—CONSTRUCTION OF HEATER ELEMENT AND RADIATOR WITH HEATER APPLIED

may be constructed at low cost induction heaters which are practically noiseless and which operate at 95 per cent or even higher power factors. The construction as well as performance of three types of heaters built according to this new design are described here. One type is for heating water for a tank, another for heating a house in connection with the ordinary hot-water radiator system, and the third is for heating water as it is drawn from the faucet.

In each case the iron pipe through which the heated water flows forms the transformer core. The secondary is made by winding bare copper wire tightly around the pipe and sweating it into a continuous sheath. The primary is insulated from the secondary and consists of insulated copper wire wound around the secondary.

One model of the heater designed for continuous service is rated at 500 watts, 240 volts, 60 cycles, the electrical part being made of a core of 1-in. (25-mm.) iron pipe, a secondary of No. 24 copper wire and a primary of 3320 turns of No. 20 copper wire. A special rate of $3.60 per kilowatt per month (twenty-four hours each day) is made for this service in Seattle.

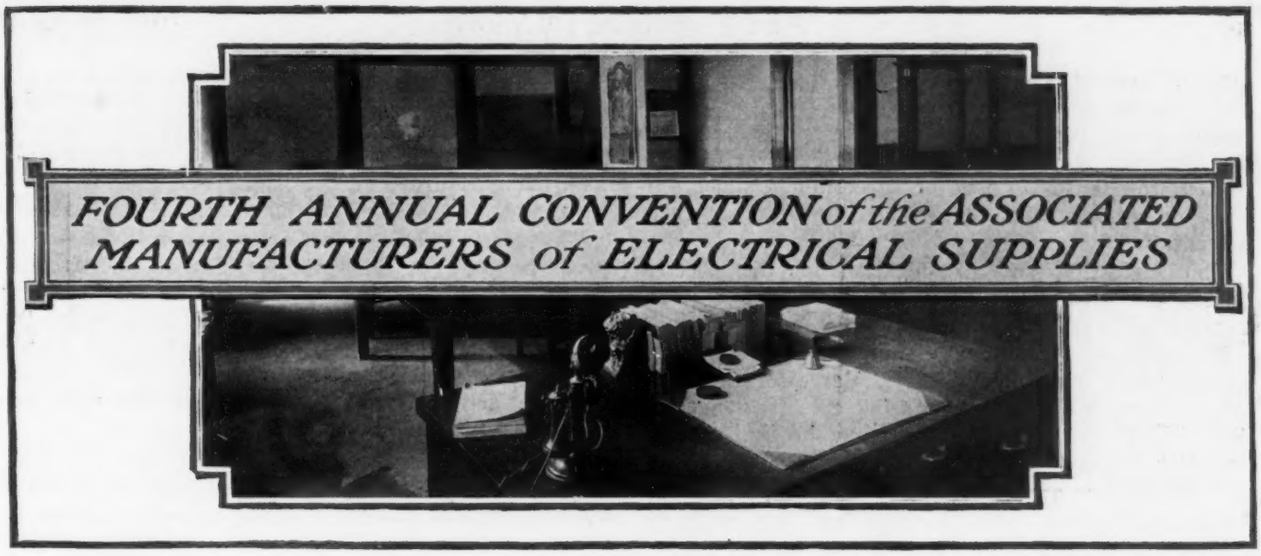
A heater similar to the one described, but rated at 2 kw., is shown herewith inserted in a three-column water radiator. In this case the primary consists of No. 18 copper wire in two coils of 1480 turns each. A side view of the radiator is shown in Fig. 2. When taking 508 watts the first heater mentioned produces a power factor of 98 per cent on a temperature of 50 deg. C. Data on the heater shown in Fig. 2 are given in the following table:

					—Temperature, Deg. C.—		
				P.F.,		—Radiator—	
Time	Volts	Amp.	Watts	Per Cent	Room	Bottom	Top
10:20	240	9.9	2315	97.5	21.5	22.5	24.0
10:30	240	9.5	2190	96.1	21.5	23.0	34.2
10:40	240	9.25	2140	96.4	21.6	30.0	43.5
11:00	240	9.1	2100	96.3	21.5	40.0	54.5
12:00	240	8.8	2030	96.2	21.8	58.0	72.0
1:00	240	8.7	2010	96.2	22.2	68.0	82.0
2:00	240	8.65	2000	96.4	23.4	70.0	82.8

The third type of heater is for intermittent service, the water being heated as it is drawn from the faucet. As a result it has to heat the water instantaneously and is rated at 2.5 kw., 125 volts and 60 cycles. The electrical part consists of a core of 3-in. (75-mm.) iron pipe, a secondary of No. 28 copper, and a primary of 318 turns of No. 14 copper. The construction of this type of heater is shown in Fig. 1. When operated at rating a power factor of 93.4 per cent was obtained at a temperature of 60 deg. C. The quantity of water heated and the temperature to which it is raised depend directly on the kilowatt output minus the heat lost by radiation and in warming the heater.

Magnet wire was used for the secondary in all the heaters mentioned, not from choice, but because neither armature wire nor aluminum could be obtained. Armature wire should be used, as the temperature inside the primary coil is considerably higher than that of the water. If the flux density of the iron is below saturation, the humming sound due to transformer action is very low. The primary coil may also be impregnated with sodium silicate or some other heat-resisting filler to minimize the vibration. During last winter several heaters similar to the one shown in Fig. 2 gave very satisfactory service in heating drafting rooms in the Puget Sound Navy Yard. Armature wire was used in the primary, and the coil was impregnated with sodium silicate. The sound emitted was barely audible close to the radiator and caused no inconvenience to the draftsman.

THE ignorance of our people with respect to the mere technique of investing is truly amazing. While the Liberty loan campaigns have rendered a service of immeasurable value in blazing the trail, much remains to be done in bringing about a thorough understanding on the part of the wage earner as to what a coupon is, how to buy and how to safeguard his investment. The increase in wages can only be maintained if it is accompanied by thrift on the part of the wage earners, and by their promptly putting back the money into money-earning enterprises. It is for this very reason that it is an economic necessity to teach the little fellow how to save and invest.—*Paul M. Warburg.*



FOURTH ANNUAL CONVENTION of the ASSOCIATED MANUFACTURERS of ELECTRICAL SUPPLIES

MEMBERS of the Associated Manufacturers of Electrical Supplies, meeting for their fourth annual convention at Delmonico's, New York, on March 20, reviewed their work under strenuous war conditions and heard thoughtful presentations of their new opportunities and problems. Results of the co-operative war service work in the national crisis were emphasized. The addresses also brought out clearly the conspicuous accomplishments in other measures touching the electrical manufacturing industry more directly. There were definite forecasts of further constructive effort in the coming year.

Calling the convention to order at 2:30 p. m., the vice-president, B. E. Salisbury, Pass & Seymour, Inc., explained that he was presiding in the absence of the president, A. W. Berresford, in Europe. Mr. Salisbury read the annual address prepared by Mr. Berresford in review of the work and prospects of the association.

The President's Address

President Berresford expressed in his address his great personal regret at his absence from the annual meeting, which was due to conditions beyond his control.

The history of the past year, Mr. Berresford said, is an embodiment of the setting aside of personal interest, and of ends achieved by conscientious effort directed to the public good and exerted through earnest self-sacrifice. Of the war work of the association, its members and the electrical manufacturing industry he said:

> The need of the nation required the doing of certain work, and we have ample reason to point with pride to the willing service rendered by our membership and to the part it has taken in making possible the successful outcome of the great struggle. Members of the Associated Manufacturers of Electrical Supplies made up the larger part of the supply division of the general war service organization and in addition provided by far the largest number of those engaged actively in the work. Although in many instances the chairmen of the section and of the corresponding group were different individuals, in practically every instance they were members of the association. In the group committee organization they carried more than their share. That this was but natural by reason of the character and activity of our association detracts not at all from the credit due. We have reason to be proud and we are proud.

Mr. Berresford then took up the subject of organization for reconstruction, saying:

> The work of the war service organization as such is practically complete, but there lie before us the problems of providing an organization for reconstruction which shall voice competently and authoritatively the needs of the industry as a whole and which shall represent adequately the interest of its least considerable member. The plans for this are in process under the auspices of the Electrical Manufacturers' Council, and our earnest effort will again be asked in the forwarding of them.
>
> That there is need for such an organization is obvious. There are always before us the matters ordinarily handled by association and which can be dealt with in no other way. It is evident that the completeness of an organization is a direct measure of the effectiveness with which these questions may be handled and of the extent to which the decisions reached will be adopted.
>
> At the moment, however, there are questions of greater possibilities than these and which, by their very nature, render essential a most thoroughly representative organization. The government proposes in one way and another to coöperate with industry. To permit of this coöperation the government must be made acquainted with the needs of industry, and this acquaintance can be had only if industry places its needs clearly and authoritatively before the government.
>
> The men who establish the actual contact must know and be able to prove that they are actually speaking for the industry as a whole, for they will certainly be questioned as to this. To have behind them simply this or that association would render their efforts futile, unless these associations comprise practically the entire industry.
>
> It has seemed best to develop the reconstruction organization through the existing associations, and to do this effectively will require the same quality of conscientious service and self-sacrificing effort in the common interest as you have accorded to the work of the war service. I know that you will give it.

In congratulating the association on the international trade committee President Berresford said that at the time that an investigation of the tariff situation was proposed many looked upon the proposition as of generic rather than specific interest. In its effect on the country in general it must react on the industry, but in individual lines only had it made evident its direct effect.

"To-day, with the world conditions as they are," added Mr. Berresford, "we see that it vitally affects each one of us, and the value of the work already done and the imperative need for doing far more is borne in upon us with increasing weight.

"The object sought is to be able at the proper time to present to the Tariff Commission a consistent and warranted demand for the protection essential to each

class of product and to do this for the entire industry. Arrangements have been made for the coördination of our work with that of the apparatus manufacturers as represented in the Electric Power Club, so that there shall exist none of the conflicts and differences of opinion which so frequently obscure a proper presentation."

The formation and organization of the Electric Safety Conference were discussed by Mr. Berresford as reported in another column of this issue.

Possibilities of combination under the Webb-Pomerene act were mentioned by Mr. Berresford. "Some attention has been given to possible combination under the Webb-Pomerene bill, and it may be that the International Trade Committee will address you in the near future on this subject," he said. "Certain plans are in process in an effort to place the possibilities before the industry in concrete form, and these may mature at an early date. The problem is complicated by many considerations and is of no small magnitude, but there seem to be probabilities of satisfactory solution and the purpose is to advise you fully as soon as definite statements can be made. Such an organization must, of course, be entirely apart from this association."

In conclusion, Mr. Berresford spoke of the actual need for closer and at the same time more representative association if the grave problems now presenting themselves are to be solved to the full advantage of the industry. They cannot be solved individually—they must be solved coöperatively.

"There must be active, aggressive allegiance and well-informed, intelligent participation," said Mr. Berresford. "The amount of time employed, comparatively speaking, is small, the resulting benefit out of all proportion."

Annual Report of the General Secretary

Charles E. Dustin, the general secretary, then read his annual report. Referring to the fact that the association is about to start on the fifth year of its activities, and recalling its small beginning, Mr. Dustin said that it has gradually grown to a position of influence and standing. The accomplishments of the sections have had a far-reaching influence for good in bringing together manufacturers in the electrical industry who might not meet in any other way, in adopting measures of standardization and conservation, and have been a means for the general betterment of the whole electrical manufacturing industry.

There are now, completely organized and doing splendid constructive work, said Mr. Dustin, twenty-five sections and several others under process of organization. The situation in connection with the Underwriters' Laboratories, the National Fire Protection Association and its work has been very satisfactorily handled by the representative of the association on the electrical committee of the N. F. P. A., Howard R. Sargent. [Later in the meeting Mr. Sargent made a brief report of what has been done for the good of the industry.]

As approved by counsel and authorized by the board of governors, the work of tabulating industrial statistics for the section members has been continued, many additional sections taking advantage of this means of obtaining valuable information of much benefit to all. This work includes the tabulation of statistics pertaining to the products handled by members, compilation of sales covering certain defined periods, tabulation of costs, movement of tonnage, etc. These figures are sent to the office of the general secretary by the individual manufacturers, tabulations are prepared and copies are sent to each member entitled to them, the original figures being returned to the maker and the identity of the company furnishing the figures in no way disclosed.

The interlocking standardization committee has made great progress in its work, Mr. Dustin added. This is given to each section interested. It has been suggested that all sections hold their June meetings this year at the Hotel Griswold, New London, Conn., as was done last year. A letter has been sent to the various sections to elicit their view in the matter. The dates proposed are June 16, 17 and 18.

Charles Blizard, Electric Storage Battery Company, presented the report of the finance committee, of which he is chairman. Expenses of the association were increased as a result of the war and the larger activities arising from investigation of the tariff situation.

Report of International Trade Committee

John J. Gibson, Westinghouse Electric & Manufacturing Company, then presented his report as chairman of the international trade committee. He described the development of its work. In referring to the appointment of William Burgess, Trenton, N. J., as adviser to the committee, Mr. Gibson spoke of the conversation which he and Mr. Burgess had with Chairman Taussig of the Tariff Commission. The commission expressed a desire to coöperate fully with the committee in its work of analyzing the industry. It was stated, however, that the commission preferred to work with the industry as a unit.

This illustrated, said Mr. Gibson, "the necessity for very close coöperation on our part with any other association or group of electrical manufacturers who take up the same line of work and the necessity for all such effort in the electrical industry to be thoroughly coördinated so that a united front might be presented at Washington on this important matter.

"Your committee has therefore recommended to the board of governors that its work be carried on in very close coördination with the work of a tariff committee appointed in the Electric Power Club, and arrangements have been proposed (or have been completed) by which the desires of the Tariff Commission will be met by having the committees of the two organizations mentioned act jointly in this matter.

"While the membership of the two organizations mentioned does not include all of the electrical manufacturers in this country, still the membership lists cover so great a percentage of the electrical manufacturers in number, size and importance that it may be considered as being representative of the industry. Should, however, other manufacturers not members of other organizations desire to act in this matter, arrangements can be made by which committees appointed by such groups may act jointly with the tariff committee of the Electric Power Club and your committee."

The first subject in connection with the tariff which the committee took up, said Mr. Gibson, was a study of the administrative features of the existing tariff bill, the revision of which was then in the hands of the United States Tariff Commission. Representations made by the Tariff Commission by the adviser to the committee as to the wrong and imperfect operation of certain features of the administrative laws were not

without effect and had great influence with the Tariff Commission in the work of revision.

The next work taken up was that of analyzing electrical products as to their component materials. Mr. Gibson added:

> This was undertaken in order to find out the effect of the present law under which a large bulk of electrical apparatus would be classified as to import duty rates according to the component material of chief value. Reports on this subject from a large majority of our membership indicated clearly that such a method of classifying electrical apparatus was illogical since the determining factor, the component material of chief value, was not the element of cost which caused the need for a protective tariff. Furthermore, the use of such determining factor actually resulted in inconsistent and in some cases ridiculous differences of classification in the same lines of product, the import customs rates actually changing in some instances with sizes of the same article.
>
> The results proved clearly that it was necessary to make a more thorough analysis of the costs of electrical products along the lines of the percentage of cost involved in labor, material and overhead.
>
> This study has brought out clearly the great question of whether the electrical industry desires to have separate consideration in any new tariff bill under a separate electrical schedule, or whether it desires to take its chances as to what it may get in the way of protection if it permits its goods to be classified at random under other schedules, the determining factors in these being matters not electrical or not directly connected therewith.
>
> Should it be decided that the electrical industry wants a separate schedule, the next question is one which must be determined by each section of the association as representing its branch of the industry, and that question is what rate of import customs duties is necessary for proper protection. Any claim made by any branch of the industry must be supported by scientifically collected data to prove that the protection is needed.
>
> This work is now under way, and, considering the fact that it is quite probable that a new tariff bill will be introduced in the new session of Congress, the work should be prosecuted very vigorously in order that we may be in a position to answer when called upon by the United States Tariff Commission.

Mr. Gibson then told of the work done on matters dealing with export trade. The committee has given careful attention to the subject of classification of electrical apparatus for use of the Census Bureau, the Bureau of Foreign and Domestic Commerce and the Tariff Commission. A statistician has been employed, and it may be necessary to secure additional assistants.

NEED OF TARIFF REVISION

Following the presentation of this report, William Burgess, tariff adviser to the committee, read a paper discussing some of the questions involved in the study of this subject. He indicated that new conditions affect the tariff issue. Viewed from the standpoint of revenue production it does not mean what it meant in the past, the requirements of the nation are now so much larger than they were. But from the standpoint of protection it is more important than ever before that the interests of the industries be safeguarded. Mr. Burgess expressed the opinion that when Congress is called in session again the question of the tariff will be taken up promptly. He emphasized the importance of a separate classification for electrical manufactures and showed the growth of that industry in Japan.

Joseph McElroy, 3d, export sales manager Pass & Seymour, Inc., gave a world view of the "Opportunities for the Sale of American Electrical Articles in Foreign Countries."

Thomas M. Debevoise, general counsel of the association, pointed out the opportunities for combination for export trade under the Webb-Pomerene act. The association or corporation formed for this purpose must be organized solely for export purposes and engaged solely in export business. If electrical manufacturers act together under the new law, they must form an independent body. If manufacturers unite in this way in separate groups representing distinct lines of manufacture, they could not offer through the resulting organizations complete lines to foreign consumers. But if the groups had a common selling agency the result would be that complete lines could be offered. That is the ideal to be kept in mind, though it may not be reached for some time. Judge Debevoise expressed the opinion that the main thing to do if manufacturers proceed under the Webb-Pomerene act is to start on as simple a basis as possible and slowly progress toward the ultimate goal of a common selling agency.

Howard R. Sargent, General Electric Company, made a report as representative of the association on the electrical committee of the N. F. P. A.

W. T. Pringle, Pringle Electrical Manufacturing Company, national councilor representing the association in the United States Chamber of Commerce, made a report on the work of the year affecting the two organizations.

In calling upon chairmen of sections for any reports they cared to make Vice-president Salisbury expressed much gratification at the manner in which these subsidiary organizations are doing their work.

Joseph Rockhill, General Insulate Company, chairman Molded and Formed Insulation Section, spoke of the activities of that section. It had held its own fairly well and performed its patriotic duty to the nation, he said. Mr. Rockhill discussed the unrest in conditions and the uncertainty in the material situation. He felt that coöperation was never more urgent than now.

BANQUET AND ELECTION OF OFFICERS

As chairman of the nominating committee R. E. Gallaher, New York Insulated Wire & Cable Company, presented for governors for three years from April 1: LeRoy Clarke, Safety Insulated Wire & Cable Company; J. J. Gibson, Westinghouse Electric & Manufacturing Company; J. W. Perry, H. W. Johns-Manville Company; Warren Ripple, George Cutter Company; W. C. Robinson, National Metal Molding Company. The secretary was instructed to cast a ballot for the nominees.

At the banquet held on the evening of the same day, also at Delmonico's, addresses were made by Robert K. Sheppard, Simplex Wire & Cable Company; Gov. Walter E. Edge of New Jersey and Major Paul Debevoise of the 312th Infantry, U. S. A. Mr. Sheppard spoke feelingly of the service flag of the association. It was suspended in the banquet room and showed 32,929 stars with 278 gold stars. The Maunfacturers' Chorus of Bridgeport, Conn., of which George S. Hadley, secretary Harvey Hubbell, Inc., is director, entertained the large number of members and guests present.

The board of governors, meeting at the conclusion of the annual meeting, reëlected as president A. W. Berresford, Cutler-Hammer Manufacturing Company. J. F. Kerlin, Corliss Carbon Company, was elected vice-president. J. W. Perry, H. W. Johns-Manville Company, was reëlected treasurer, and Charles E. Dustin general secretary.

Power Supply for Atlantic Seaboard

Comprehensive Scope of Plan of Secretary of Interior Lane for Development of Super-Power Stations in Boston-Washington District Described by W. S. Murray Before the A. I. E. E.

W. S. MURRAY, consulting engineer of New York, discussed before the American Institute of Electrical Engineers at Boston on March 14 the plan of Secretary of the Interior Lane for meeting the power needs of the Atlantic seaboard district between Washington and Boston.

Turning to the plan of trunk-line power supply lately fostered by Secretary Lane, Mr. Murray pointed out that in 1914 he had become interested as an engineer in the possibilities of centralized motive-power supply for the six principal railroads operating into the New York City district on the western side of the Hudson River —the Lehigh Valley, Central New Jersey, Delaware, Lackawanna & Western, Pennsylvania, West Shore and Erie roads. Here appeared an excellent opportunity to form a power equipment company to work out a standard equipment for service in this district. Power might be supplied from a station of from 100,000 kw. to 200,000 kw. rating in the Hackensack meadows. In view of the financial embarrassment of the railroads it appeared that the financing might be taken out of the hands of the transportation companies and handled by equipment trust bonds. Power houses, shops and equipment might have been financed in this way.

Billions for Conservation

The above plan gradually developed into a regional one, as it was studied. "I offer you this slogan," said Mr. Murray: "We have spent billions of dollars for destruction for preservation. Let us now spend billions of dollars for construction for conservation." Continuing, he said: "It is without a shadow of a doubt in my own mind that as sure as we are sitting here to-day the waste by improper power application on the Atlantic seaboard between Washington and Boston amounts to between $50,000,000 and $100,000,000 a year, and probably much more. Think of the millions of tons of coal that are wasted between those two points in the proportion of freight, passenger and switching tonnage. Think of the millions of tons that are wasted in the factories of that district, of the millions of dollars that are wasted owing to the higher maintenance cost of the steam locomotive as against the electric locomotive. Think of the millions of dollars that are lost by virtue of the steam locomotive being unable to consolidate behind it train tonnage equal to that of the electrical engine. Then integrate these millions and you will only approximate the totals I have given you.

"It should be borne in mind, as Secretary Lane has pointed out in a recent presentation of this matter, that it is not the intent to ignore the needs of other sections, or to suggest that there are no other regions in which similar opportunities for improvement in power supply exist; but our beginning must be made somewhere, and it is here on the North Atlantic seaboard where density is at a maximum that the greatest economic return can be effected, not to speak of the elimination in the future of the serious deficiency in power our industries were facing during the closing days of the war.

"Now to return to our Atlantic seaboard conditions. Why are we allowing all this waste? It is like everything else in this country. We have had so much we have not known what to do with it. The time has come when we owe it to posterity to brace up and change our name from that of a nation of wealth to a nation of economists. We can help the world far more if later we can claim justice to the latter title.

"I have given much thought to Secretary Lane's proposed super-power generation, transmission and distribution plan for application in the regional districts between Boston and Washington. By such an arrangement is offered the opportunity of propelling all trains in this region by electricity and at the same time supplying all industrial concerns with like power. I am most thoroughly in accord with the Secretary's advances in regard to this matter. He has in contemplation a system of trunk-line transmission between Boston and Washington, the route of which will lie sufficiently removed from the coast, as a military precaution, and which would employ the use of steel transmission towers supporting wires bearing three-phase, 25-cycle current at a potential, say, of 150,000 volts—these lines, probably three or four in number, lying parallel to each other and on private right-of-way.

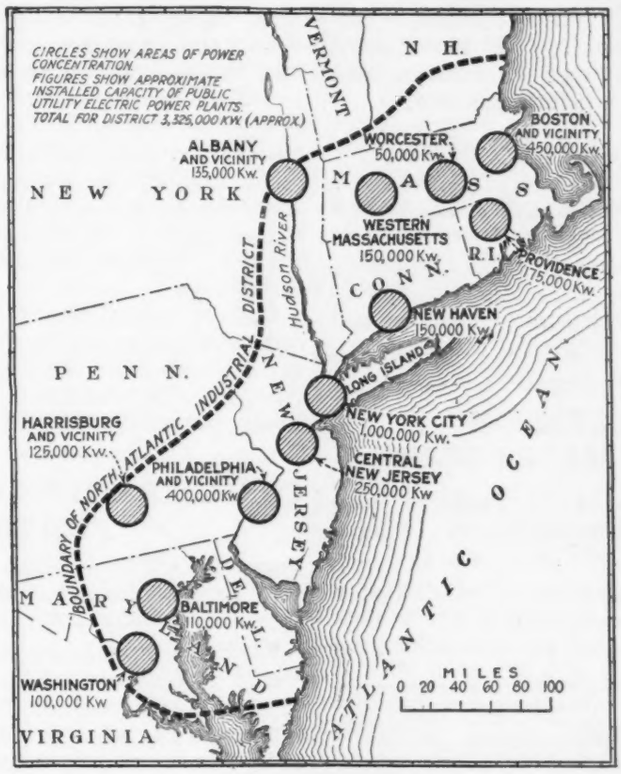
"Such lines should be energized through large-unit tidewater steam-electric stations, hydroelectric stations and steam-electric stations at coal-mining centers. The specific location of the stations would conform with conditions conducive toward highest economy based on transmission efficiency, diversity factor, and breakdown service between plants. It is a practical conception to think of such stations of the steam order furnishing a kilowatt-hour to these lines at a rate between 10 lb. and 15 lb. (4.5 kg. to 6.8 kg.) of steam; the water plants furnishing their quota of course without robbing the earth of a pound of coal. The southward sweep of such a transmission system would probably bisect the line between the anthracite coal mines of Pennsylvania and tidewater, offering opportunity to use the millions of tons of culm coal now wasting and unavailable for power service, also coal at present being mined and now wasted for the reasons named.

Vast Economies Possible

"I ask you to exercise your imagination and visualize the economies which would be rendered on such a system. I think I can speak with authority on the railroad end of this matter, as ten years' constant observation on fuel economy as between steam and electric service has shown that the electric passenger engine, ton for ton on drivers, will handle trains of equal weight mile per mile for one-half the coal consumed in steam practice. In the case of freight operation this is even better, being two and one-half to one, while in switching the ratio becomes three to one. These are not guesses but facts, supported by records of millions of ton-miles in the three classes of service mentioned. In our factories electric driving will average a coal saving of two to one. . . . Skeptics may say that such a plan as offered by the Secretary of the Interior is all

imagination. The part that had to be imagined is there, and rightly there; the part that is not imagined represents practicability, for it offers at once the challenge that if power can be produced at such rates—and we know that it can—there is a growing market for it; and in order to compete in the world market while maintaining the American standard of wage and living we must have Secretary Lane's super-power plan clearly presented before the American Congress and we must back it up."

Mr. Murray said that at first blush the super-power plan would appear to be a "large order." "This is so," he said, "but the world is full of big problems and of as big men to solve them. We are on the verge of very large things. Professor Breckenridge of Yale University states that the production of bituminous coal is now over 500,000,000 tons yearly compared with 100,000,000 only a few years ago. From 750,000,000 to 100,000,000 tons of anthracite coal per year are being mined, and it is estimated that in seventy-five years the supply of the latter will be virtually exhausted. The importance of reducing the fuel consumption per kilowatt-hour can hardly be exaggerated. The amount of wasted coal in this country, especially in the eastern district, is almost criminal. We have learned to think in billions of dollars, and when we view it in the proper perspective, with relation to the resources of the country, the super-power plan takes its place modestly in line with normal development and brings out the real sense of proportion it bears to the necessary expansion of all the arts that the future must bring.



PROPOSED SCHEME OF INTERCONNECTION FOR NORTH ATLANTIC POWER SYSTEMS

"We have been prone to think of our railroads," said Mr. Murray, "as great arteries capable of meeting the exigencies of any industrial expansion. Were I to plot it in the form of two straight lines referred to rectilinear coördinates, I could see industrialism moving upward and away from transportation, with 30 degrees between them; but alas! it is worse than this. The curve of industrialism is more logarithmic than rectilinear, and while transportation may make a doubtful claim of a constant rate of acceleration, industrialism, so ably represented in power to drive it ahead, has an ever-increasing rate of acceleration, and the angle widens between them for every increment of time. . . . Ten years ago if the super-power plan had been suggested it would have died a natural death. The supporting traffic was not here. It is here now and growing every minute. The railroads are a common carrier for general commodities. The super-power transmission will be a common carrier for power. To-day coal is preempting 33 per cent of our railroad carge space. It congests and consequently deters other shipments. As we recall the New England winter of 1917-18, what arguments can rise in our minds against the proposed new common carrier of power, the response of which will be instantaneous to the throw of a switch?"

In closing, Mr. Murray referred to hydroelectric and interconnection work in Connecticut, which is expected to save in the vicinity of 500,000 tons of coal annually, and touched upon the possibilities of supplying hydroelectric energy to Philadelphia from a development which appears feasible in Pike County. About 90,000 kw. is required at Philadelphia. The water-power project investigated involves a reservoir with a storage capacity of 7,500,000,000 cu.ft. (210,000,000 cu.m.), a watershed of 240 sq. miles (62,000 hectares), rainfall of 32 in. (81.3 cm.), and a fall of 350 ft. (105 m.) in the stream in a run of 5500 ft. (1676 m.). A drawdown of 26 ft. (7.9 m.) is permissible. Development could be effected up to 100,000 kw. The total cost of the project, including a 102-mile (164-km.) transmission line, is about the same as of an equivalent steam plant at tidewater, but the operating expense of the water-power plant figures an estimated saving of about $1,000,000 per year. The super-power scheme, Mr. Murray said, could be extended to Portland, Me., on the north and to Richmond, Va., on the south, if desirable. The speaker said he had not found one dissenting voice among his engineering, commercial and railroad friends regarding the investigation that Secretary Lane has proposed into the economies of the super-power system. "This nation," said Mr. Murray, "owes a job to every soldier, be he returning from Europe or from his post in the United States. There are two million sons of America returning from overseas. Can they not fairly ask, 'Have you been thinking of us over here while we have been fighting for you over there?' Millions have been spent in factory and in field to accomplish the construction and purpose of this super-power transmission and distribution. It will, while creating a new national wealth, automatically provide ways and means for the employment of American labor and be a fair answer to the fair question of the returning soldier."

Books Received

PUBLIC UTILITY RATE FIXING. By C. E. Grunsky. San Francisco: Technical Publishing Company. 169 pages. Price, $2.50.

ANNUAIRE POUR L'AN 1919. With Scientific Information. Published by the Bureau of Longitudes. Paris: Gauthier-Villars et Cie. Price, 3 francs.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

CHANGE IN TEST VOLTAGE

Action Taken by Transformer Manufacturers Regarding Winding-to-Core Test Voltage

Since transformers having low-voltage ratings in the 2300-volt class are very frequently connected in Y by operating companies to supply 4000-volt secondary distribution, manufacturers belonging to the Electric Power Club have decided to adopt the following test voltages between low-voltage winding and core:

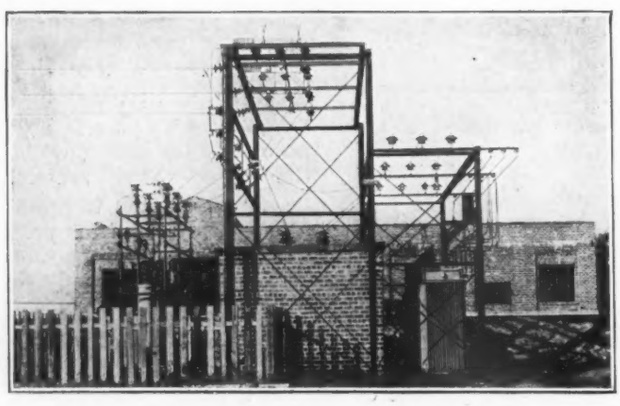
Highest Operating Voltage	Test Voltage
1500 and less	4,000 volts
1501 to 4500	10,000 volts
4501 and greater	Twice the highest operating voltage of the low-voltage winding plus 1000 volts

This change from the practice that has previously existed will make the voltage comparable with the insulation test voltage required between high-voltage and low-voltage windings on transformers of this class.

OUTDOOR MINE SUBSTATION WITH BRICK METER HOUSING

Made with Expanded Metal Poles, Pin-Type Insulators, Unit-Type Equipment and Air-Break Switches

The outdoor substation illustrated is installed at a coal mine controlled by a public utility. Among its important features are the low cost per kilowatt-ampere,



EQUIPMENT PERMITS EASY INSTALLATION

the use of standard unit-type equipment which can be assembled in special arrangements to meet local conditions, and the speed of installation, thus keeping the labor costs at a minimum. The structure made of expanded steel sections occupies a ground area of 20 ft. by 10 ft. 7½ in. (6 m. by 3 m.), giving sufficient space for a house in which high-tension automatic oil-switch and metering equipment may be installed. Attached to the main tower is a steel extension carrying the transformer buses and providing space underneath for four 300-kva., 33,000/2200-volt, single-phase transformers, one of which is a spare.

A high-tension three-pole double-break-per-phase switch is equipped with choke coils which reflect incoming disturbances to the lightning arrester. This switch is of the remote-control, manually operated, interlocking type, enabling all three poles to be simultaneously opened and closed from ground level by means of a common handle which can be locked in either position. Between the electrolytic arrester and the incoming lines is a set of single-pole disconnecting switches equipped with carbon-tetrachloride limit fuses.

The high-tension bus supports are of the unit type, interchangeable in design with insulators on the switching equipment. The low-tension supports are also of the unit type, with adjustable fittings, permitting easy installation.

Outdoor substations of this type meet the modern demand for economy in material, as they permit the use of a minimum amount of steel in the supporting structure. This information was contributed by H. W Young, president of the Delta-Star Electric Company.

CONSIDERATIONS ON THE FUSIBILITY OF COAL ASH

Formation of Clinkers Due to Melting of the Ash Constituents May Be Reduced by Careful Consideration of Melting Point

Fusibility tests as made in the laboratory are not usually directly comparable to the conditions existing when coal is burned in the furnace, but analysis of clinkers from boiler furnaces indicates that clinkers easily form when iron is present in the ash in the ferrous state. Consequently the values obtained in the laboratory are in this respect comparable to the actual fuel-bed conditions and give the lowest temperatures at which the intimately mixed ash will soften, forming clinker. The accompanying table of fusibility of coal ash, compiled by the United States Bureau of Mines, gives the average values for different coal beds in each region. The temperature taken as the softening point is that at which an ash pyramid ¾ in. (19 mm.) high and ¼ in. (6.4 mm.) wide at the side of the base, mounted in a vertical position, will fuse down to a spherical lump. The temperatures at which the tips of the cones first fused and at which the ash became very fluid are also taken and serve mainly as an indication of the viscosity of the melting ash. These values are not tabulated. The low softening temperature of the ash from the coals of the Middle West is probably due to the pyrite, gypsum and calcide that occur so generally as impurities in coal from the interior of this country. In general it might be said that the individual mines are producing coal having a lower sulphur content than the average sulphur value given for the bed in which they occur. Further, the fusibility temperature

of the ash is higher at many of the individual mines than indicated in the table for the bed:

TABLE I—FUSIBILITY OF COAL ASH FROM THE INTERIOR OF UNITED STATES

Region, State, Bed	Number of Mines Sampled	Total Number of Samples	Average Softening Temperature, Deg. Fahr.	Ash in Dry Coal, Average Per Cent.	Sulphur in Dry Coal, Average Per Cent.
Eastern Region:					
Illinois					
No. 1 bed	1	6	2110	11.74	4.86
No. 2 bed	6	15	2010	9.97	3.58
No. 5 bed	9	27	1990	10.84	3.28
No. 6 bed	36	160	2160	10.27	2.39
No. 7 bed	2	13	2050	10.62	2.69
Indiana					
No. 3 bed	3	11	2090	10.41	4.34
No. 4 bed	7	30	2390	8.17	1.62
No. 5 bed	9	29	2110	10.23	3.54
No. 6 bed	1	5	2040	9.91	.65
Minshall bed	1	1	2120	9.60	2.99
Western Kentucky					
No. 6 bed	1	4	2130	8.81	2.97
No. 9 bed	20	78	2030	10.53	3.67
No. 10 bed	2	2	1990	11.99	4.18
No. 11 bed	7	39	2030	9.57	4.08
No. 12 bed	3	17	2150	10.20	2.30
Western Region:					
Kansas					
Bevier bed	2	6	1980	14.83	4.71
Cherokee bed	3	8	2110	9.42	3.18
Leavenworth bed	1	3	2020	18.26	5.46
Weir-Pittsburgh bed	3	7	2010	11.68	5.31
Missouri					
Bevier bed	16	42	1960	13.47	4.90
Bowen bed	1	3	1940	13.18	4.61
Cainsville bed	1	3	1980	12.71	5.78
Cherokee bed	1	3	2150	7.51	1.97
Jordan bed	4	12	2010	12.74	4.42
Lexington bed	14	39	2000	13.48	4.04
Lower Rich Hill bed	3	8	1940	15.39	5.43
Lower Weir-Pgh. bed	2	6	1940	10.78	4.45
Mulberry bed	2	5	1990	14.58	3.18
Mulky bed	4	9	1940	11.28	5.25
Rich Hill bed	1	3	1970	15.47	6.12
Tebo bed	8	23	2040	11.64	4.66
Waverly bed	1	2	2020	17.43	8.29
Oklahoma					
Dawson bed	3	3	1920	8.95	3.91
Henryetta bed	2	2	1980	8.03	1.59
Lehigh coal bed	3	15	2150	11.46	4.17
Lower Hartshorne bed	9	27	2020	6.03	1.43
McAlester bed	6	28	2180	6.94	1.67
McCurtain bed	1	6	2110	6.92	0.84
Panama bed	2	4	2160	6.81	1.46
Stigler bed	5	5	2050	5.13	1.91
Upper Hartshorne bed	3	7	2170	6.15	1.51
Arkansas					
Denning bed	1	3	2200	7.38	2.45
Hartshorne bed	5	9	2120	11.59	1.40
Paris bed	1	3	2140	10.12	3.28
Shinn Basin bed	1	1	2180	10.36	2.23
Southwestern Region:					
Texas					
S.nto Tomas	2	2	2580	19.21	1.98

ALTERNATING-CURRENT MOTORS FAVORED IN STEEL PLANT

Records of Direct-Current and Alternating-Current Motor Failures and Cost of Repairs in Bethlehem Steel Plant

During a five months' test period (ended Dec. 1, 1918) in the machine shop of the Lehigh plant of the Bethlehem Steel Company 137 alternating-current motors showed a perfect service record. During the same period there were twenty-six total failures among 353 direct-current variable-speed motors and thirty-nine total failures among 342 direct-current constant-speed motors. These 832 motors had an aggregate rating of 7195 hp., making the average motor size 7.2 hp. The maximum rating was 25 hp. and the minimum 0.5 hp.

The actual cost of repairs to a group of 200 motors in the same shop was investigated. These motors averaged about 4.3 hp. each, which is about 40 per cent less than the average of 7.2 hp. for the entire shop. There were twenty-seven total failures in this group during the five months, and the failures all occurred in the direct-current motors, of which there were 150. The fifty alternating-current motors showed a perfect record.

A large percentage of the failures originated in the commutators; where the breakdown did not actually occur at this point the commutator had to be at least repaired. In addition to such repairs or renewals about 40 per cent of the armatures had to be rewound. In repairing the twenty-seven armatures that failed about 432 hours were spent, involving a total cost of about $475, of which $260 was for labor and $215 for material. At this rate the annual expense would be $1,140.

The foregoing maintenance cost is based on twenty-seven failures in one group of motors in five months. However, in that same period there were sixty-five total motor failures in that shop and 432 machine-tool motor failures in the entire plant. The constant-speed motor failures could be reduced to a negligible quantity by using only alternating-current motors for that service. Such a change should reduce the complete motor failures and the total motor maintenance expense by 40 per cent or more.

This information is based on a paper read by H. W. Tice before the Philadelphia Section of the Association of Iron and Steel Electrical Engineers.

STANDARD RATINGS OF THREE-PHASE TRANSFORMERS

Revisions Made by Representative Manufacturers at a Recent Meeting Held by the Electric Power Club

By taking care not to order three-phase distribution transformers whose ratings are not listed in the accompanying table, engineers will avoid the extra delay and expense which are always involved in procuring special units. The list represents the standard ratings adopted by the Electric Power Club at a recent meeting and hence will represent the manufacturers' attitude in the matter. For transformers of this class, oil-immersed self-cooled units and frequencies of 25 and 60 cycles are standard.

STANDARD THREE-PHASE DISTRIBUTION-TRANSFORMER RATINGS

Standard Line Voltages	Standard Sizes for Each Voltage Class Inclusive*	For Supplying Service Voltages 600 and Below: Transformer High-Voltage Ratings for Operation from Various Standard Line Voltages — On Full Winding	Approximately On Taps 10 per Cent.	Transformer Low-Voltage Ratings for Supplying Service Voltages 600 and Below
2,300	5 to 200	2,200/3810Y	.....	.... to 220/440
		2,300/4000Y	.....	.... to **230/460**
		2,400/4150Y	.....	.... to 240/480
4,600	5 to 200	4,400Y	.....	.... to 220/440
		4,600Y	.....	.... to **230/460**
		4,800Y	.....	.... to 240/480
6,600	10 to 200	6,600Y	5,940	.... to 220/440
		6,900Y	6,210	.... to **230/460**
		7,200Y	6,480	.... to 240/480
11,000	10 to 200	11,000Y	9,900	.... to 220/440
		11,500Y	10,350	.... to **230/460**
13,200	10 to 200	13,200Y	11,880	.... to 220/440
		13,800Y	12,420	.... to **230/460**
22,000	10 to 200	22,000Y	19,800	.... to 220/440
		23,000Y	20,700	.... to **230/460**
33,000	25 to 200	33,000Y	29,700	.... to 220/440
		34,500Y	31,050	.... to **230/460**

* Standard sizes in kva. continuous ratings at 55 deg. C. rise: 5, 7.5, 10, 15, 25, 37.5, 50, 75, 100, 150, 200.

Heavy type indicates normal voltage ratings on which guarantees will be made. It is understood, however, that where a transformer is suitable for operation at two volage ratings or at three voltage ratings, this flexibility will be definitely indicated on the nameplate, on the connection diagram or on a paster inside the transformer cover.

All sizes of distribution transformers having low-voltage ratings of 230/460 volts are suitable for series or multiple three-phase service only by proper connection inside of the tank.

Standard transformers having voltage ratings listed above will be designed for full rated kva. output at any specified tap voltage without exceeding guaranteed temperature rise.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

INTERESTING COST DATA ON 1200 ELECTRIC RANGES

Byllesby Properties Show Annual Income of $55.39 per Range, with Low Installation and Maintenance Costs

Information collected by the publicity department of H. M. Byllesby & Company on the ranges at practically all of the company's properties as of Jan. 1, 1919, showed that there were 1200 ranges connected to the company's lines. The energy consumed by these ranges during 1918 was 1,550,036 kw.-hr., or an average of not quite 108 kw.-hr. per month per customer.

All of the properties have not gone into the range business on the same scale. The number of ranges in service at the various properties investigated varies all the way fron one range to as many as 650 ranges. The lowest rate charged at any property is about 2½ cents per kilowatt-hour, while at one place the rate charged is as high as 8 cents. The total energy income from these 1200 ranges during the year 1918 was $60,270.38, or an average of $55.39 per range.

While the installation costs shown on the table are in no wise complete, they give a fair conception of what may be expected in various American communities. The average outside installation costs, according to the figures given in the table, amount to $68.95. It is quite probable that for some cities this figure would be too low. It is particularly noticeable that the larger cities show higher installation costs, and it is probable that the figure of $128, which is given for Minneapolis, might be taken as a fair average figure for a large city.

As calculated from the data in the table, the cost of inside installations averages $30. It is noticeable that this figure coincides exactly with that given for Minneapolis and agrees approximately with the figure at San Diego.

Apparently not all of the companies have kept accurate records as to the cost of maintenance of electric ranges, but the data secured from those which have kept these costs show an average maintenance cost per range of $2.89. This figure appears to be strikingly low in comparison with the annual income of $55.39.

That the properties from which these figures were taken are not at all saturated with range business is evident from the fact that the commercial departments of the properties themselves have estimated that there are more than twice as many prospective purchasers of electric ranges as there are range customers.

BROOKLYN COMPANY RESUMES HOUSE-WIRING CAMPAIGNS

Rejuvenated Plan Presents Prices for Wiring One Room, One Floor or Entire House on Liberal Installment Plan

Beginning April 1, the Brooklyn Edison Company resumes its house-wiring campaigns on already built houses in Brooklyn. The Brooklyn plan of electrifying old houses has worked out most successfully in the past, securing for the central station many thousands of residences along its existing mains. The rejuvenated plan presents a schedule of prices for the wiring of one

ELECTRIC RANGE SITUATION AT PROPERTIES OF H. M. BYLLESBY & COMPANY, JAN. 1, 1919

Name of Company	Number Ranges in Service	Average No. 1918	Total Kw.-Hr. Consumption, 1918	Total Revenue, 1918	Average Income per Range	Rate (Net), Cents	Installation Cost Outside	Installation Cost Inside	Company Maintenance Cost	Ranges Removed	Number of Prospects
Dallas	20	16	22,883	$845.42	$52.81	4½ 1st 30 3½ 2nd 30 2½ all over	$80.00	$24.00	$20.00	2	30
Enid	1	1	94	12.05	12.05	Reg. power rate	0	0	0	0	0
Eureka	7	7	10,246	352.82	50.40	33 1st 150 Sunday 0.005	12.00	.....	0	1	3
Everett	1	1	.....	24.00	24.00	5	9.00	.....	0	0	0
Faribault	17	15	14,400	590.00	39.33	45.	15.00	12.50	.....	1	.....
Kalispell	159	145	263,831	5,936.20	40.94	2½	50.00	28.00	1,500.00	12	100
Louisville	43	22	90,000	3,000.00	136.36	3	100.00	90.00	.....	0	650
Minneapolis	650	594	715,000	36,000.00	60.60	3	128.00	30.00	1,250.00	12	1,500
Montevideo	14	14	22,022	836.70	59.76	4	45.00	25.00	9.00	0	.....
Hutchinson	10	10	14,025	544.62	54.46	4	47.00	22.00	2.50	1	3
Pipestone	0	2	186	20.21	10.11	4	.....	.....	0	..	6
Norman	19	21	15,732	1,133.16	53.96	8	85.00	18.00	.....	0	0
Oklahoma City	2	2	4,960	248.00	124.00	5	80.00	18.00	.....	0	6
Richmond	10	9	16,683	414.02	46.00	3.3	100.00	75.00	.....	1	300
San Diego	119*	80	187,679†	4,586.13†	57.32	3.33	140.77	25.00	646.56	0	250
St. Paul	7	7	6,335	390.76	55.82	7.3 1st, 5.2 thereafter	100.00	35.00	0	0	Many
Sioux Falls	22	22	12,468	681.00	30.95	5.5	5.00	6.00	7.00	1	40
Stillwater	98	120	153,492	4,655.29	38.79	3	41.29	12.50	0	.0	122
Totals	1,200	1,088	1,550,036	$60,270.38	$55.39	.....	$1,033.06	$421.00	$3,435.06	31	3,000

* Besides 128 water heaters. † Including water heaters.

room, one floor or the entire house and includes fixtures, glassware and tungsten lamps. A liberal partial payment feature is offered, with payments as low as $2 a month, extending over a period of twelve months if desired. A new set of fixtures of the Adam design has been selected which it is expected will make the plan more attractive and salable than ever before. The fixtures of the dining room, living room, library, bedrooms and main hall are operated by a center-switch control which is easy and convenient to operate and saves the expense of wall switches. By the new method, one or all of the lights in each fixture may be operated as desired. A combination bowl and shower dining-room fixture has been substituted for the dome which formed an essential part of the old plan. This affords a better illumination and can be conveniently used with appliances on the dining-room table. On all pull-chain socket fixtures a new arrangement has been adopted whereby sockets will be of 660 watts capacity, which will permit the use of any appliances. The following schedule gives the prices to be charged and which are for single apartments and residences along the commercial mains of the company. They are based upon acceptance within ten days of quotation. Certificates of approval of the Department of Water Supply, Gas and Electricity and of the New York Board of Fire Underwriters will be furnished:

No. 1, Kitchen.—Ceiling outlet with one-light fixture, pull-chain socket, 50-watt tungsten lamp, shade and a baseboard or side-wall flush receptacle, located in kitchen on the first floor, $21.45.

No. 2, Cellar.—Ceiling receptacle with 50-watt tungsten lamp located in cellar near heating apparatus operated by a flush switch at head of cellar stairs, $11.90.

No. 3, Dining Room.—Ceiling outlet with three-light shower fixture, center switch control, shades and 50-watt tungsten lamps, $17.80. (No. 3a—If combination bowl and shower fixture is desired instead, add $2.75.)

No. 4, Parlor.—Ceiling outlet with four-light shower fixture, center-switch control, shades and 50-watt tungsten lamps, $16.90.

No. 5, Library.—Ceiling outlet with 15-in. bowl fixture, two lamp sockets, and 50-watt tungsten lamps operated by a center control switch, $17.

No. 6, Main Hall.—Ceiling outlet in hall with one-light chain fixture, pull-chain control, shade and 50-watt tungsten lamp, $12.60.

(If wall bracket is desired instead, deduct $3.15.)

No. 7, Bedroom.—Ceiling outlet with two-light shower fixture, center-switch control, shades and 50-watt tungsten lamp, $12.50.

No. 8, Piazza.—Ceiling outlet on piazza with ceiling fixture, 50-watt tungsten lamp and ball shade, switch located in hall, $15.

No. 9, Bathroom.—Side-wall outlet, one-light nickel-plated fixture, pull-chain socket, shade and 50-watt tungsten lamp, $8.45.

No. 10, Pantry.—Side-wall outlet, one-light bracket fixture with pull-chain socket, shade and 50-watt tungsten lamp, $8.30.

No. 11, China Closet.—Side-wall outlet, one-light bracket fixture with pull-chain socket, shade and 50-watt tungsten lamp, $8.30.

No. 12, All Other Outlets.—Other lighting outlets, one-light bracket fixture, pull-chain socket, shade and 50-watt tungsten lamp, $8.30.

No. 13.—Two three-way switches for controlling hall light from upper and lower floors, $15.85.

No. 14.—Baseboard, wall and ceiling receptacles, each $7.15.

No. 15.—Floor receptacles, $9.90.

No. 16.—Bell-ringing transformers for alternating current only (this device does away with all trouble and expense of dry and wet batteries), $7.90.

No. 17.—Single-pole flush wall switches, each, $7.15.

No. 18.—For running risers through additional floors in houses of more than one family add $7.15 for each floor above the first floor. (In this schedule the floor above the cellar is considered the first floor.)

Deductions for fixtures if personal selection is desired: No. 1, $2.30; No. 3, $9.20; No. 3a (bowl and shower), $11.95; No. 4, $10.35; No. 5, $10.45; No. 6, $4.90; No. 7, $5.95; No. 8, $1.15; No. 9, $1.90; Nos. 10, 11 and 12, each, $1.75.

The soliciting for this class of business is done entirely by the company's salesmen, but the actual work of installation is performed by the electrical contractor designated by the customer. This method of awarding contracts has worked out most satisfactorily to all concerned, and all the Brooklyn contractors have again signified their desire to coöperate with the company in the same manner as heretofore.

UTILITIES' RELATION TO APPLIANCE SALES

A Discussion of the Essentials for the Successful Merchandising of Socket Devices in Any Community

Central stations should create a desire on the part of the public to own and use electrical appliances in order to improve the load factor and keep up the revenue of their residential business. This was the thought expressed by W. S. Head, manager of the commercial service department of the Duluth (Minn.) Edison Electric Company, in a paper read on March 20 before the Minnesota Electrical Association. To keep the utility's rates from defeating the very purpose for which appliances are sold, it was pointed out that the following features should be embodied in the rate schedule:

1. The minimum charge should be high enough to cover the ready-to-serve charge, but not high enough to make a large percentage of the public non-users because they do not expect to use the service represented by the minimum charge.

2. Rates should stimulate use of service through one meter by decreasing the cost per kilowatt-hour with increased use and improved load factor.

3. Schedules should be designed for small unit profit from a large volume of business.

The proper rates are not everything, however; the public should be educated in the advantages, care and application of electrical household appliances. When this shall have been accomplished and the old ideas of fear and mystery dispelled, consumers will seek to purchase appliances of their own accord.

Consumers buy from both central station and contractor-dealers, and for the benefit of all concerned these two classes of merchants should each use clean, fair, non-discriminatory sales methods. If a customer gets something which fails because it is a cheap, faulty appliance, the tendency is for him to throw it away and condemn all electrical appliances. However, the best equipment needs repairing sometimes, and provision should be made for doing such work promptly and without undue trouble to the user. It is also desirable to reconcile conflicting statements by different retailers on the operating cost and characteristics of the same appliance. Conflicting statements breed suspicion in the mind of the customer. It is held that all these problems can be successfully solved if the best energies of the central stations and the contractor-dealers are combined and subjected to the same general direction.

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Lamps and Lighting

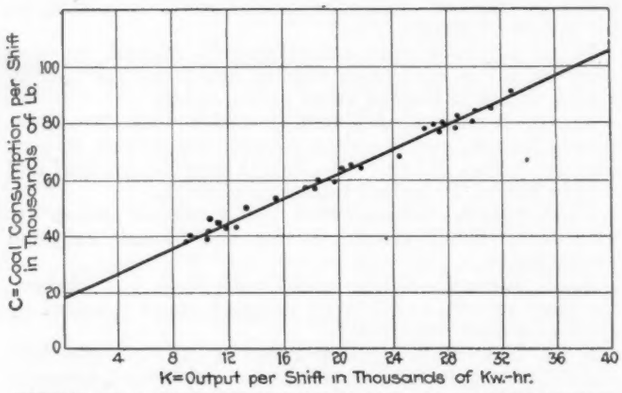
Electric Incandescent Lamp Situation in France.—A. Larnaude gives some interesting facts regarding the electric incandescent lamp situation in France. Carbon lamps are now used only in cases where great strength of filament is required. Vacuum lamps with tungsten filaments are considered to work at 1.1 to 1.3 watts per candle and to give a useful life of 1000 to 1200 hours. Gas-filled lamps are giving 400 to 3000 candles at about 0.6 watt per candlepower. Owing to the high temperature of incandescence attained the finest wires will not resist adequately in an atmosphere of nitrogen, and lamps giving less than 300 cp. to 400 cp. at 110 volts require argon, which M. Claude is now preparing on an industrial scale. The thermal conductivity of argon bears to that of nitrogen the relation 1 : 1.5—a difference which is sufficient to render practicable lamps giving 50 cp. to 100 cp., operating at less than 1 watt per candle and having a normal useful life. Owing to the low dielectric cohesion of argon gas (only 38 as compared with 465) it is, however, necessary to employ a mixture of argon and nitrogen. In a 50-cp. lamp about 400 mm. of wire is used. Here M. Larnaude also points out the great variation in distribution of candlepower met with in modern incandescent lamps and emphasizes the desirability of expressing values in lumens.—*Illuminating Engineer*, August, 1918.

Generation, Transmission and Distribution

Present Development of Transmission Lines in Kansas.—F. ELLIS JOHNSON.—A study of the development of transmission systems in the State of Kansas was undertaken with the idea of aiding in the future electrical development of the state. Extensive tables are presented giving physical data of interest in connection with the Kansas transmission lines. There is also an appendix giving a brief summary of the considerations involved in the design of iron and steel transmission lines.—*Bulletin of the University of Kansas*, No. 12, June 15, 1918.

The "Bayerwerk" Electricity Scheme.—In 1915 O. V. Miller drafted a scheme, since developed and now adopted by the Bavarian government, under which the Bayerwerk is to establish a high-tension network to distribute electrical energy over an area including Munich, Augsburg, Dettingen, Schweinfurt, Nuremberg, Wurzburg, Bamberg, Bayreuth, Amberg, Haidof, Regensburg, Landshut and Kochel. Energy will be collected from the Walchenseewerk, from state water-power stations to be erected from time to time, and from power houses having available surplus energy at economical rates. The Walchensee station is to develop 50,000 kw. and deliver to the network 150,000,000 kw.-hr. per annum at 100,000 volts, three-phase. It is proposed to supply energy only in bulk, to large consumers who will erect their own transformer stations and distribution networks. A list is given in the original paper of firms and municipalities interested in the foundation of the Bayerwerk. The state is to put up 51 per cent of the 10,000,000 marks capital and other shareholders the remaining 49 per cent. The state reserves the right to purchase the entire undertaking after fifty years at a price equal to the first cost minus 1 per cent per annum.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elektrot. Zeits.*, Sept. 12, 1918.)

Coal Consumption of Steam-Power Plants.—ROBERT H. PARSONS.—It is the purpose of the article to suggest practical methods of keeping check on the efficient use of fuel shift by shift, whatever may be the output of the plant. The writer suggests the preparation of charts similar to that shown in the illustration whereby it may be shown what the normal coal consumption should be for any value of station output. This curve is seen to be a straight line, the equation for which is represented by the author as $c = 18{,}000 + 2.2\ k$, k representing the output per shift in thousands of kilo-



NORMAL COAL CONSUMPTION FOR VALUES OF STATION OUTPUT

watt-hours and c being the coal consumption per shift in thousands of pounds. Similar charts may be prepared for checking the important parts of the plant operation, such as water rates, in terms of station output.—London *Electrical Review*, Feb. 21, 1919.

Tests on Steam-Engine Governing.—A. GRAMBERG.—Tests were made on a non-condensing horizontal steam engine with a view to elucidating the phenomena occurring during automatic governing. The engine was equipped on the high-pressure cylinder with Collmann valve gear and controlled by a ball governor. Curves are given showing the sleeve travel as a function of speed for various sleeve pressures; also the governor position for various speeds and adjustments. For the purpose of the tests there was added to the governor shaft a spindle on which weights could be placed at definite intervals above and below the governor shaft. The increase in these forces due to these weights is approximately proportional to the paths traveled by the governor sleeve, the speed of rise being approximately proportional to the distance either above or below the

weights from the governor shaft. Horizontal displacement of the weights affects the speed of rotation but not the degree of lack of uniformity of governing. The behavior of the curves of equal engine output is interesting. At higher speeds a smaller torque corresponds to the increased output; a higher position of the governor would hence be expected. This occurs at all loads, but not when the set runs idle; in the latter case the internal resistance of the set determines what happens. Varying the vertical setting of the auxiliary weights does not affect the average speed of the engine but varies the degree of lack of uniformity.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Dingler's Polytechnical Journal*, Feb. 23, 1918).

Traction

Hints for the Freight Operator.—A. B. COLE.—The writer points out the fact that the market train service has provided a lucrative business in connection with interurban traffic. It should also be undertaken by steam railways where it is possible to adopt electric locomotives for this service. The writer discusses the possibility of using motor cars, trailers and electric locomotives. He also points out the proper signaling required for safe operation of this freight service.—*Electric Railway Journal*, March 1, 1919.

Operation of Street-Railway System of New Orleans.—H. W. T. HOGG.—The writer discusses the problem of the rehabilitation of the street-railway systems of New Orleans. The subject matter of the report may be divided into five groups, namely, (1) rerouting the car lines, (2) routing the cars, (3) number of cars required, (4) labor problem, and (5) the reorganization problem.—*Proceedings of the Louisiana Engineering Society*, February, 1919.

Swiss Report on Corrosion by Earth Currents of Electric Railways.—This is the second part of the report (for the first part see *Abs.* 667, 1918), and deals chiefly with the form and size of the corrosion phenomena met with in practice and their causes. Corrosion may be due to two causes, either chemical or electrical. The former is first considered. Rust, in the narrow sense, is defined as the red oxide of iron formed by the action of air and water; but in a wider sense it may be taken as including insoluble basic salts of iron formed by the action of acids in the soil. Wrought-iron pipes seem to be destroyed more readily than cast-iron by rust in the narrow sense, though this may be due to the fact that large cast-iron pipes are often laid deeper and hence further from the oxygen of the air. But where it is a question of acids cast iron is more readily destroyed than wrought. Soils containing calcium and magnesium sulphate or cinders are especially dangerous. Corrosion due to earth currents may be caused by mechanical destruction of insulating coverings, which then become a danger rather than a protection, since the current density may be so high as to cause serious damage in conditions otherwise favorable. The case of pipes laid parallel to electric rails is considered, as being more amenable to mathematical treatment. In such a case the potential drop between pipe and rail varies from 0.5 volt to 3 volts for a characteristic operating period. Increases up to 5 volts may occur. The resistance of the earth varies according to its composition and moisture content, but mortar and cement have a much higher conductivity than ordinary soil. A table is quoted giving the current density required to reduce the wall of a pipe to one-half its original thickness in twenty, thirty, forty or fifty years. Happer went thoroughly into the question of protection by means of insulating joints and coverings, investigating the influence of inorganic joints, alloys, oxides, silicates and wrappings of paper, cloth, cement, etc., and found none of them could be relied on with certainty. Screwed or riveted joints in wrought iron show no great increase in resistance, but a socket joint is equivalent to 30 m. of pipe.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Schweiz. Elektrot. Verein*, August, 1918.)

Installations, Systems and Appliances

Electricity in the Ceramic Arts.—J. P. ALEXANDER.—Until recent years electricity had not been introduced into pottery and tile-making factories for the reason that it had been generally supposed that a steam engine, by reason of the excess power it could produce over its normal rating, was the only driver that could start up the machinery after the clay had settled in the mixing tubs overnight. Recent electrical installations have shown the fallacy of this idea and have proved to ceramic engineers that the electric motor can duplicate any of the engine drives. In the article here noted the processes employed in the pottery industry, etc., and the service of electricity in this field are well outlined.—*General Electric Review*, February, 1919.

Electric Heating and Cooking.—FRANK BROADBENT. The writer states that even were electric cooking more expensive than cooking by the use of gas or coal the economy in food itself would be sufficient justification for the use of electricity. As typical of results obtained in one of the London national kitchens, it is stated that the loss in weight of beef cooked by various methods is approximately as follows: By gas, 32 per cent; by coal, 30 per cent; by electricity, 12 per cent. Even better results were obtained in the cooking of mutton. Other advantages of using electricity in cooking are stated.—*Beama Journal*, January, 1919.

Boiler Units with Air Reheaters.—Description of an installation of the Underfeed Stoker Company in an English central station by means of which the heat contained in the hot gases which escape from the fireboxes is advantageously used to heat air blown under the grates by electric motors mounted upon the framework of the grates.—*Revue Générale de l'Electricité*, Feb. 15, 1919.

Phenomena of Water Hammer.—C. CAMICHEL, D. EYDOUX and M. GABIEL.—In two previous articles on this subject M. Gabiel has studied the maxima of water hammer at the distributing point and at the gateway of a conduit and has indicated applicable formulas (*Revue Générale*, Sept. 21 and Oct. 5, 1918). In this article the authors deal with water hammer occurring along the length of the conduit and give formulas for calculating it at every point for conduits of constant diameter and constant or variable thickness where the opening and closing are in a straight section of the pipe.—*Revue Générale de l'Electricité*, Feb. 15, 1919.

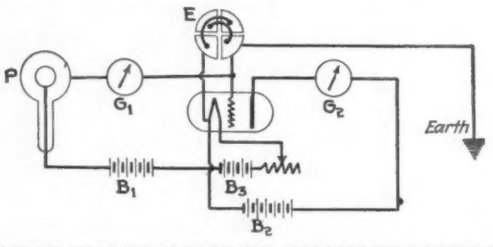
Protective Effect of Reactance Coils.—O. BOHM.—The author applies his method of investigation, which previously dealt with the case of transformer windings, to the case of protective choking coils.—*Science Abstracts, Section* B, Jan. 31, 1919. Abstracted from *Elektrot. u. Maschinenbau*, Aug. 25, 1918.)

Practical Phases of Boiler-Room Practices.—EDWARD MARSHALL.—Considerable progress has recently been

made in the operation of boilers owing to the fact that a great many had to be more or less reconstructed in order to burn a poorer quality of coal than that for which they were designed originally. More attention has been given to operating data than ever before, and few companies now operate their boilers without keeping some record of the percentage of ash to the amount of coal burned or without a record showing just the proper time to clean the boilers both inside and out. Instead of the old method of blowing down boilers two or three times a day some titration method is used to determine when blowing down is necessary. The author cites some typical experiences such as the case of a plant where extremely high chimney temperature was corrected by reconstructing the baffling and where an excess of exhaust steam was used to bring up the temperature of the feed water. He also calls attention to the necessity of keeping in closer personal touch with employees in order to gain better results and also to prevent excessive labor turnover.—*Ohio Electric Light Association Monthly*, February, 1919.

Electrophysics and Magnetism

Amplification of the Photoelectric Current.—CARL ELI PIKE.—A method has been outlined by Jakob Kunz by means of which the photoelectric current may be amplified, thus making the photoelectric cell more useful



CONNECTION OF VACUUM TUBE FOR AMPLIFYING PHOTOELECTRIC CURRENTS

as a photometer, especially in the region of ultra-violet light and also for technical purposes. By means of the audion as indicated in the diagram the author has shown that photoelectric current can be amplified from 1600 to 5000 times. With different audions amplifications of 18,000 have been obtained.—*Physical Review*, February, 1919.

Telegraphy, Telephony and Signals

Couplings in High-Frequency Amplifiers.—J. SCOTT TAGGART.—The circuits described in this article are complete wireless receiving circuits and possess the advantage of not employing either intermediary transformers or oscillatory circuits between the valves.—*Wireless World*, February, 1919.

Graphical Method of Calculating the Attenuation Constant of Loaded Telephone Circuits.—It is stated that the method of the author can be applied to advantage on almost all loaded lines, including open-wire aërial lines, underground and submarine cables. Charts are offered for the calculation of such lines, and numerical examples are worked out.—*Post Office Electric Engineers' Journal*, January, 1919.

Oscillating Valve.—E. V. APPLETON.—The most important relations in a double-anode valve are those between plate voltage, plate current and grid voltage when the filament temperature is constant. It is the aim of this article to show how the conditions required for the production of continuous electric oscillations by any three-electrode valve can be foretold from its static characteristics.—*Wireless World*, January, 1919.

The Fundamental Wave and the Harmonics in a Homogeneous and in a Non-homogeneous Antenna.—L. DUBAR.—Sequel to an article by M. Chireix (*Revue Générale*, Sept. 14, 1918) in which in many simple cases of non-homogeneous antennas formulas of the distribution of currents and voltages and equations giving the proper wave lengths were established. In this article the equations are solved, approximately at least, and conclusions concerning the distribution of harmonics in some simple hypothetical cases are drawn.—*Revue Générale de l'Electricité*, Feb. 22, 1919.

The Development of the Telegraph in France.—J. B. POMEY.—After a brief historic summary relative to the underground telegraphic network which was established in France following the war of 1870, the author shows that to-day the construction and exploitation of a great network of this kind presents no technical difficulty and that, all things considered, such a network is financially more economical than the existing networks with aërial wires. He also contends that it is now in the general interest of the telegraphic service to plan the construction of a great network of cables with multiple conductors of which some sections could be carried aërially on concrete poles as is done in the United States.—*Revue Générale de l'Electricité*, Feb. 22, 1919.

Miscellaneous

Electricity in Agriculture.—A system is described involving the use of elevated rail tracks which are permanently erected parallel to each other on opposite sides of the area to be cultivated to carry traveling electric motors by means of which the hauling necessary for draining and plowing are accomplished.—London *Electrical Review*, Jan. 10, 1919.

Electro-Culture Experiments by the South Wales Power Company.—An outline is given showing the apparatus required and the amount of energy used per acre on considerable tracts of land subjected to the stimulation of the electrical field. It appeared that a considerable increase in production was attained.—London *Electrician*, Jan. 17, 1919.

Magnetos for Oil Engines.—E. BIFFI.—A large number of experiments upon a Bosch magneto are reported in this article. The type experimented on was that for an eight-cylinder oil engine with fixed coils and rotating magnetic armature core. The maximum induction in the core was found to be 9700 c.g.s. lines per square centimeter. A large number of diagrams and curves illustrate the article.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elettrotecnica*, Aug. 5, Aug. 25, Oct. 5 and Oct. 15, 1918.)

Flow of Water Through 1½-In.-Diameter Pipe and Valves.—FREDERICK W. GREVE, JR.—The following conclusions are based on the work and curves are produced: The relation of loss of head to discharge in all cases can be represented by the general equation $H_l = MQ_n$; that M and n both vary with the restriction of area to flow through the valves, decreasing with increase in values of d/D; that Weisbach's coefficients, which show average values for small gate valves, give values of H_l that are too small, and that a gate valve causes less loss of head than a globe valve and that the losses are nearly equal for $d/D = 0.23$.—*Bulletin* No. 1, Engineering Experiment Station, Purdue University.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

SHIP SCHENECTADY IS LAUNCHED AT HOG ISLAND

Eighteenth Ship Is Given Name of City of New York State in Recognition of Work Done by General Electric Company

In recognition of the work done by the General Electric Company, which is furnishing all of the turbines for the ships built at Hog Island, the eighteenth ship to be launched from those yards was christened "Schenectady" as she slid off the ways on March 15. Miss Miriam Rohrer, daughter of A. L. Rohrer, electrical superintendent of the General Electric Company, was sponsor.

WISCONSIN ASSOCIATION ON SERVICE AND SECURITIES

Papers Delivered at Wednesday Session of Convention View Utility from the Angles of Banker, Commissioner and Operator

Service first was the paramount thought of the first day's session of the Wisconsin Electrical Association, which met in annual convention at the Hotel Pfister, Milwaukee, March 26 and 27. In an address on "Public Utilities and Securities" Chester Corey of the Harris Trust and Savings Bank, Chicago, stated that the successful banker must always be ready to furnish money to the utility on reasonable terms and the chief problem of the utility is to maintain the proper credit. He said that it is generally conceded that an interurban railway which does not earn more than $2,000 a mile is not entitled to credit. Another type of company not entitled to credit is one having faulty capitalization. If fixed charges amount to 85 per cent of earnings, fluctuation of prices may very easily wipe out the 15 per cent margin. Any company to retain good credit should earn one and one-half times its fixed charges. Mr. Corey believed that private ownership under public management conduces to most economical and efficient management.

An address on "Safety and Sanitation" by R. McA. Keown, engineer of the Industrial Commission of Wisconsin, was followed by a paper on "The Value of the Quality of Service" by Commissioner John S. Alen, Railroad Commission of Wisconsin.

President John St. John, assistant general manager Milwaukee Northern Railway, Cedarburg, Wis. recommended in his address that hereafter the convention be divided into two parts, one to deal with problems relating to light and power companies and the other to take up problems of interest to railway companies.

A paper on "Public Utilities Rendering Service to Industries" was read by N. J. Whelan of the Wisconsin-Minnesota Light & Power Company, Eau Claire.

W. L. Goodwin also addressed the association, explaining his merchandising plan and the work he has done to coördinate the interests of the dealer-contractors and the central-station men. In behalf of dealer-contractors he urged coöperation in Wisconsin. A committee was appointed to confer on this subject with a committee from the dealer-contractors' association.

CONVENTION COMMITTEES OF N. E. L. A. ARRANGE PROGRAM

Domestic, Commercial and Industrial Lighting to Be Featured by Exhibits, Lectures and Reports at Atlantic City Gathering

Six committees of the National Electric Light Association held meetings in Chicago March 24, 25 and 26. In these meetings the plans of the committees were crystallized and definite programs were worked out. The committees were the lighting sales bureau, the power sales bureau, the merchandising committee, the executive committee of the Commercial Section, the overhead-lines committee and the safety and accident prevention committee. A feature of the activities of the lighting sales bureau will be a fifteen-thousand-dollar exhibit which will be prepared in conjunction with the lamp committee, partly at the expense of the lamp manufacturers.

Some of the reports which will be submitted by the lighting sales bureau are on the commercial aspects of lamp apparatus, electrical advertising, outdoor lighting, residence lighting, lighting of public buildings and store lighting. There will also be a paper on probable causes of decreases in revenue and methods of remedying these conditions. W. A. Durgin, Chicago, will make an address and give a demonstration on industrial lighting. The power sales bureau plans to discuss live topics of the day, particularly those in which interest was stimulated by the war. Discussions from the floor rather than set papers will prevail in this meeting. The topics to be discussed include electrochemistry, the effect of the war on isolated-plant costs, electric furnaces for the three purposes of melting steel, melting non-ferrous metals and heat-treating metals, electric welding, desirability of correcting power factor in customers' installations, and industrial electric trucks and tractors. The efforts of the merchandising committee will be confined mainly to bringing its 1915 report up to date. Important features of the report will be data on a uniform accounting system, discussions of merchandising profit and advertising by small stations. The principal topic before the overhead-lines committee was inductive interference. The safety and accident prevention committee devoted considerable time to the National Electrical Safety Code.

Among entertainment features are dinners to be given by the lighting sales bureau and the power sales bureau. In order to be able to stage a still more elaborate entertainment program these two bureaus will combine after the dinners in a joint celebration.

DUTIES OF AN ENGINEER IN GOVERNMENT AFFAIRS

Discussion on Means and Methods of Increasing Productivity of Labor—Need of Organization to Voice Engineering Opinion on Public Questions

The local sections of eighteen engineering societies representing different phases of the engineering profession in Greater New York met on Wednesday evening under the chairmanship of Gano Dunn, past-president of the American Institute of Electrical Engineers, to discuss the relation of the engineer to public activities beyond the limits of his technical horizon. Different angles for discussion were assigned to the five leading speakers. They indicated why engineers should accept civic responsibility and should influence legislation; how the engineer can be used to advantage in governmental administration, also what the engineer can do to influence public opinion and allay popular unrest.

"We have emerged from the war with a political unrest in which the voice of reason is drowned between the clamor of labor and the sentimental appeal of visionary reformers," said Philip N. Moore, past-president of the American Institute of Mechanical Engineers, in his address on the "Civic Responsibility of the Engneer." "Now, as never before, we need the trained mind of the engineer to think clearly with unflinching logic from cause to effect."

Calvert Townley, past vice-president of the American Institute of Electrical Engineers, said in the course of his talk on "The Relation of the Engineer to Legislation" that "an engineering training fits a man to arrive at logical conclusions regardless of outside influences and he is therefore qualified to express opinions on legislative and other subjects outside his field. Engineers must concentrate on certain specific lines and be persistent if much is to be done with legislatures."

That the trained engineer is the logical man for the management of undertakings involving the planning and execution of engineering was the conclusion of Nelson P. Lewis, vice-president of the American Society of Civil Engineers, in his paper entitled "The Relation of the Engineer to Administration."

"Morale is as important to the engineer as to the soldier," said Spencer Miller, vice-president of the American Society of Mechanical Engineers, who spoke on the "Relation of the Engineer to Public Opinion." The "spirit," in its broadest sense, back of the man wins in engineering as in other fields. Engineers are widely respected for their character, and anything which builds character will create better public opinion. A simple code of ethics was advocated to which all engineers could subscribe.

Comfort A. Adams, president of the American Institute of Electrical Engineers, in his paper on the "Relations of the Engineer to Distribution and Production" pointed out that if engineers could so improve methods and machinery that the productivity of labor would be increased until it is possible to pay labor a real living wage and still have a fair return for capital, then they will have the remedy for the present undercurrent of industrial unrest. "We are now paying a high price for having exploited cheap foreign labor," he said, "because the most active discontent to-day is in that group of people. Engineers must face the facts fairly and unless we take an intelligent step forward the great tank of discontent will crush us and all we represent."

Dr. C. A. Doremus, S. N. Cassell, Daniel Turner, F. Skinner, J. G. Johnson, H. A. Pratt, Lieut. Van Gelder, Farley Osgood, C. F. Scott, J. K. Thompson, Louis C. Marburg, and L. G. Graton were among those who contributed to the discussion.

EXHIBIT OF WAR WORK PHYSICAL APPARATUS

To Be Held Under the Auspices of American Physical Society at Bureau of Standards, Washington, from April 25 to 30

In connection with the annual meeting of the American Physical Society, April 25 and 26, it is planned to have an exhibit of physical apparatus illustrating the application of physical principles to the solution of war problems. In view of the fact that the National Academy of Sciences will be in session in Washington on April 28 to 30, inclusive, it is planned to hold the exhibit open through April 30.

The council of the Physical Society has selected the following committee to make arrangements for the Washington meeting, with powers to add to its membership: G. K. Burgess, chairman; E. B. Rosa, G. O. Squier, A. W. Duff, J. A. Ames.

At the meeting of the above committee on March 6 F. A. Wolff of the Bureau of Standards was invited to serve as a member of the committee and to take charge of the exhibit. The following statement has been issued in regard to the matter.

Object and Scope.—The main purpose of the exhibit is to present an opportunity to the physicist to inspect and see in operation new apparatus developed for war purposes, whether by the research worker or the manufacturer.

Exhibitors.—Exhibits will be accepted from military and naval establishments, universities, research institutions, manufacturers and individual investigators, whether members of the society or not. Certain military establishments have already signified their intention of participating in the exhibit. To avoid duplication of exhibits and the exhibition of apparatus which for military reasons it may be deemed unwise to show, it is suggested that prospective exhibitors first take up with the proper army or naval authorities the question of what may be properly exhibited.

Entries.—All exhibitors should furnish without delay a brief description of the apparatus which it is proposed to exhibit, together with a statement regarding space requirements (table, wall or floor). If special facilities are required to show the method of operation, ample notice should be given. In view of the space limitations, the committee feels compelled to reserve the right to accept or decline any entry, though every effort will be made to provide for all important, instructive and interesting exhibits offered.

Expenses.—Since neither the Physical Society nor the Bureau of Standards has funds available for the purpose, exhibitors will be obliged to prepay express or freight charges both ways, as well as any special expenses incident to installation and operation. The bureau will, as far as practicable, undertake to provide for hauling the exhibits and for assistance in unpacking, installing and repacking of same.

Shipping Instructions.—All exhibits should be securely packed and plainly addressed "Physical Society Exhibit, Industrial Building, Bureau of Standards, Washington, D. C." The name and address of the exhibitor should also be given. Neither the Physcial Society nor the Bureau of Standards is authorized to assume any risk of loss or breakage. All shipments must, therefore, be made at owner's risk.

Correspondence.—All correspondence regarding the exhibit should be addressed to F. A. Wolff, Bureau of Standards, Washington, D. C.

ELECTRICAL SAFETY CONFERENCE FORMED

Organized by Associated Manufacturers of Electrical Supplies, Electric Power Club, Underwriters' Laboratories and Other Bodies

Acting upon a recommendation and suggestion from the Electrical Manufacturers' Council, representing the Electrical Manufacturers' Club, the Electric Power Club and the Associated Manufacturers of Electrical Supplies, there has recently been organized a body known as the Electrical Safety Conference for the consideration of accident and safety questions relating to electrical manufactures and products. The organizations coöperating for the formation of this conference are the Associated Manufacturers of Electrical Supplies, the Electric Power Club, the Underwriters' Laboratories, the National Workmen's Compensation Service Bureau and the Bureau of Standards, each of which is represented on the conference by two members who have been appointed as follows:

For the Associated Manufacturers of Electrical Supplies—A. W. Berresford, Cutler-Hammer Company, Milwaukee, Wis.; S. L. Nicholson, Westinghouse Electric & Manufacturing Company, East Pittsburgh.

For the Electric Power Club—A. H. Moore, General Electric Company, Schenectady, N. Y.; Clarence C. Collens, 2d, Reliance Electric & Engineering Company, 1086 Ivanhoe Road, Cleveland.

For the Underwriters' Laboratories—W. H. Merrill, 207 East Ohio Street, Chicago; Dana Pierce, 25 City Hall Place, New York.

For the Bureau of Standards—Dr. Morton G. Lloyd and Dr. E. B. Rosa, Bureau of Standards, Washington, D. C.

For the National Workmen's Compensation Service Bureau—Albert W. Whitney and L. L. Hall, 45 Park Row, New York.

The officers are: A. W. Berresford, chairman; A. W. Whitney, vice-chairman; Dana Pierce, secretary-treasurer.

The objects of the conference are stated as follows:

To promote by cöoperative effort the orderly, consistent and proper development of practice in electrical manufactures and installations with regard to accident hazards.

To promote the development and adoption of safety standards for the construction and test of electrical appliances and for their application and installation.

To interpret and make uniform the application of electrical safety codes both in regard to general principles and in regard to particular classes of appliances and systems.

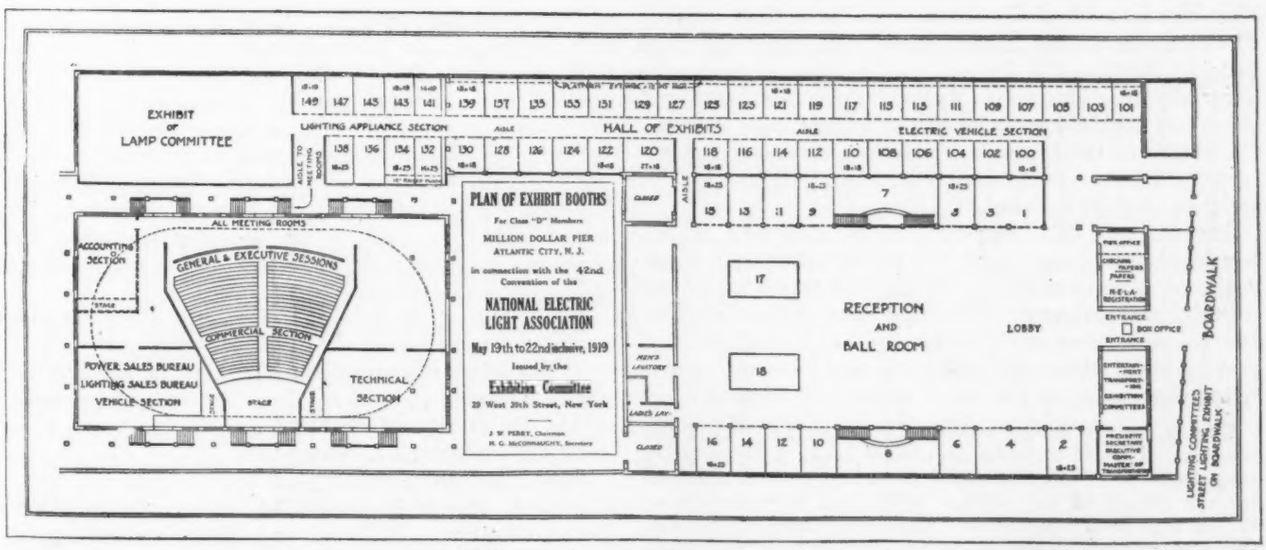
The active work of the conference as between the different coöperating associations will be conducted by means of special committees appointed from time to time, which will report back through the conference to the associations for the purpose of securing agreement and uniformity of action.

The first subject undertaken by this conference will be that of industrial controllers, on which a committee of which H. D. James of the Westinghouse Electric & Manufacturing Company is chairman, has recently been appointed. It is expected that at an early date other lines of investigation and discussion will be undertaken.

In his speech before the convention of the Associated Manufacturers of Electrial Supplies last week President A. W. Berresford of that organization said regarding the new organization:

One development of the year which is of direct interest is the formation of the Electric Safety Conference. Under the operation of workmen's compensation acts in the various states, most of which demand or permit insurance against the risk involved, the companies handling such risks found it necessary to evolve means whereby an equitable determination of the hazard could be made and the expense of providing against it properly distributed. This took the form of an organization known as the Workmen's Compensation Service Bureau, which, in a sense, occupies a relation to the casualty companies similar to that of the National Board of Fire Underwriters to the fire companies. To determine standards of installation, construction and test there was the same need of laboratory facilities. Initially it was proposed to establish casualty laboratories, but ultimately the work was, by agreement, undertaken by the Underwriters' Laboratories, and much duplication of plant and effort was avoided thereby.

Plan for Exhibits at Atlantic City Convention of National Electric Light Association



The exhibition committee of the National Electric Light Association has announced that great interest is being taken in the plan for exhibits to be held in connection with the annual convention at Atlantic City during the week beginning May 19. J. W. Perry is chairman of the committee and H. G. McConnaughy secretary.

WILL DISCUSS THE STATUS OF INDUSTRIAL LIGHTING CODES

Meeting in New York on April 11 Is to Be Joint Gathering of Illuminating Engineering Society and A. I. E. E. Committee

A joint meeting of the Illuminating Engineering Society and the lighting and illumination committee of the American Institute of Electrical Engineers will be held at the Engineering Societies Building, New York, at 8:15 o'clock on the evening of April 11. As stated previously in the ELECTRICAL WORLD, the meeting is to be devoted to a discussion of the "Present Status of Industrial Lighting Codes in the United States." G. H. Stickney, past-president of the Illuminating Engineering Society and a member of the committee on lighting legislation of that society, will present the paper of the evening. The program for the meeting is purposely limited to one paper so that there may be time for an expression of many different viewpoints.

MINNESOTA ASSOCIATION'S AFTER-WAR CONVENTION

Advisability of Revising Former Principles Considered —Frank L. Cross of St. Paul Elected President for the Ensuing Year

The twelfth annual convention of the Minnesota Electrical Association, which closed its three-day session at St. Paul on March 20, will go down in the records as most beneficial to those in attendance. While in a great majority of cases those members who had attended the previous conventions came to obtain information rather than to give it, the conference just closed showed a real disposition on the part of the members present to give their own experience as a means of obtaining the experience of others. Information about new departures in public utility practice, made necessary by the after-war readjustments which the industry is undergoing, and which are expected to result in better business and more friendly relations with the public, was listened to with keen interest and elicited lively discussions.

One of the most interesting features of the convention was an address by William C. Redfield, Secretary of Commerce of the United States, who happened to be passing through the Twin Cities, visiting Minneapolis especially to address the "better business convention." Secretary Redfield spoke of the wonderful part electricity played in helping to win the war, dwelling particularly on wireless telegraphy, wireless telephony and the guiding of ships by electrical signals.

President B. W. Cowperthwait of Faribault in his presidential address urged the united effort of the association's membership in solving the problems of industrial readjustment. "We must continue the work of the reconstruction period with the same ideals of humanity and justice that guided us when we were mobilizing our resources for war," he said, continuing:

> To-day we are facing a new era in the history of our country. That it is to be an era of great prosperity we cannot doubt. The question for us is how we can administer the affairs of the utilities which are intrusted to us to the best interests of the communities served. I make this statement advisedly because it is now well recognized that we hold a position of public trust which we are entitled to administer only as long as we do so wisely and with due consideration of the rights of the public.
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> If the war has brought out any one fact in our business it is the importance of public utilities to the economic growth of the country. We found our country able to prepare for the emergency which confronted it only as it was able to manufacture the materials of war, and the constant cry of the manufacturer has been for power and more power. This demand for power was made upon the central station at a time when every manufacturer of electrical equipment in the country was months behind on government work and no private orders could be filled without authority from the federal government.
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> Again, when the word went out to conserve fuel it was to the central station that the manufacturer turned—wasteful isolated steam plants must be abandoned and central station service substituted. It is for us to see that business so acquired is now retained and that the isolated plant be never allowed to return.
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> The country as a whole has been awakened to the necessity for conservation of our national resources. If our business is to expand it must be through the elimination of wasteful methods. I have in mind the low generating costs which can be secured by the development of large central stations, both hydroelectric and steam. These results can be brought about by the extension of transmission-line systems which are rapidly connecting the large centers with the rural communities, thus bringing the advantages of electric service to the farmer. This rapid growth of the transmission-line system is enormously extending the field for electric development. At this time I believe it would not be out of place to urge the passage of such laws as will make practicable the development of our undeveloped water powers, which were so sorely needed during the war and have greatly lightened the burden placed upon transportation.

H. L. Cross, vice-president and general manager of the St. Paul Gaslight Company, presented a paper on the reconstruction period and laid particular stress on the necessity of friendly relations with the public, not only for any particular company, but also for the industry as a whole. He advocated the use of intensive and extensive publicity campaigns as a means of keeping the public informed at all times of what the industry has done, is doing and is going to do. Mr. Cross's paper was intensely practical as well as being admirable in topic and treatment.

The discussion indicated great interest in the publicity side of the electrical industry.

D. F. Parrott, of the distribution department of the Minneapolis General Electric Company, read a paper on the recent developments in transmission-line construction for medium voltages. This paper was a concise presentation of the latest practice in line construction.

W. F. Heald, Duluth Edison Electric Company, addressed the conference on the merchandising methods for central stations and laid particular emphasis on the necessity of excluding selfish motives for the benefit of the electrical business as a whole. Closer coöperation between central stations and contractor-dealers, Mr. Heald stated, is vital to the industry and absolutely necessary to a complete understanding of the electrical industry by the public.

H. J. Meyer, Minneapolis, formerly administrative engineer for the Minnesota division of the United States Fuel Administration, outlined the work of the administration's bureau of conservation. Professor Sheperdson of the University of Minnesota presented a paper on some coming electrical developments.

Officers for the ensuing year were elected as follows: President, Frank L. Cross, St. Paul; vice-president, Leonard Peterson, Thief River Falls; second vice-president, R. M. Howard, Winona; secretary and treasurer, Meyer Barnert, St. Paul; director, W. F. Heald, Duluth.

WATER CONSERVATION PLAN IS DISCUSSED IN MASSACHUSETTS

Recommendations of Special Commission Considered at Legislative Hearing in Boston—Private Development Under Commission Supervision Favored

The recommendations of the special commission on water conservation in Massachusetts were discussed at a legislative hearing in Boston March 18, and representatives of the New England Power Company and Turners Falls Power & Electric Company appeared in favor of the general plan providing for the coöperative development of power privileges recently outlined in the ELECTRICAL WORLD.

Chairman A. R. Weed of the Massachusetts Gas and Electric Light Commission explained the report of the special commission, which has been printed as Senate Document 298, with a draft of an act designed to promote the development of water-power resources in the state and in coöperation with other neighboring states. Mr. Weed pointed out that there is now developed about 300,000 hp. on Massachusetts streams and 500,000 hp. might be made available within the state by a satisfactory conservation program. It is proposed to authorize the forming of a reservoir or improvement company along the lines of the Wisconsin law to create storage, the developments by this organization to be based on a majority in interest and in numbers among the riparian owners along the streams concerned. The annual costs of storage operation and charges would be met by tolls, with provision for triennial readjustment of tolls, and the bill provides that in case the private owners do not develop their privileges the State may ultimately develop them. Mr. Weed said that the special commission did not desire to embark upon a state-ownership or public-operation program at this time, favoring private development under the supervision of the commission on waterways.

E. E. Davis, a civil engineer of Northampton, Mass., contributed data as to the potential and developed resources of the Westfield River, as follows:

	Developed Head, Ft.	Installed Hp.	Mean Annual Output, Hp.-hr.
Present	178	6,450	39,000,000
Potential	2,303	40,000	230,000,000

PRESIDENT HARRIMAN DISCUSSES BILL

Henry I. Harriman, president of the New England Power Company and Boston Chamber of Commerce, said that the great mass of Massachusetts water powers are not worthy of development from the financial viewpoint until storage has been created to equalize to a certain degree the very low flow of the rivers. The company's Somerset reservoir has increased the minimum flow of the Deerfield River at Shelburn Falls from 50 second-feet to about 350 second-feet. Enough water has been stored to fill the little bottom valleys in the dry days of the average year, and this has been possible because the company has controlled the greater part of the power on the stream and could afford to make an investment in the reservoir because it could spread its cost over all the powers on the stream which it owned. Mr. Harriman added:

> This bill enunciates the same principle where a common ownership is impossible. It lays upon all of the parties who are benefited by the storage the obligation to pay a part of the cost. Two or three of the companies interested in power on the Connecticut River have within the last two or three years made extensive studies of the storage possibilities of the upper Connecticut. It appears that at Bellows Fall, Vt., for example, the minimum flow could be increased from 1000 second-feet to 5000 second-feet if all the various power interests on the river would pay their share of the cost.
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> At present there is developed about 300 feet on the Connecticut. While some progress has been made by private agreement between the various companies, it is not complete, and I believe that state regulation of such a matter is wise and in the public interest. The public gets a direct and immediate benefit because the rates of the public utilities using and selling hydroelectric power are regulated, and a benefit to mills and other private users is also realized. Our coal haul in New England, 600 miles from the mines, is the longest haul to any great manufacturing area in the country. Most of the other large industrial areas are within 100 or 200 miles of the mines. Water-power development should be encouraged.

Mr. Harriman suggested several amendments to the bill, among these being the granting to electric utilities of the right to develop power at the various sites, the specification of a reasonable dividend on the investment required for storage in place of a stated 6 per cent dividend, the sale of energy by the reservoir company at the dam site and the right of the parties to development to fix tolls, subject to filing with and regulation by the commission. The hearing was continued to March 25.

OPPOSE EXTENSION OF POWER OF MASSACHUSETTS COMMISSION

Representatives of Central Stations Present Arguments Against Plan to Enlarge Authority of the Gas and Electric Light Commission

At a legislative hearing in Boston on March 5, E. W. Burdett, counsel for the Massachusetts Gas and Electric Association, and Henry I. Harriman, president of the New England Power Company, opposed various recommendations of the Gas and Electric Light Commission for increased authority over the sale of bonds, for the power to specify depreciation allowances and dividend declarations and to validate street-lighting and inter-company contracts. These recommendations were detailed in the ELECTRICAL WORLD of Jan. 18, 1919, page 122. In general the opposition was to plans that would carry the commission over the border line into the managerial field.

Mr. Burdett said that he represented from sixty to seventy gas and electric companies, about forty of which sell electricity. The association is represented by an executive committee of eleven, which has given careful consideration to the bills in question. The capitalization represented totals about $50,000,000. The association feels that the time has come when, in response to the dictates of self-preservation, it must make a stand against the invasion of the business management of these corporations. All the members agree to the principles of the supervision, control and regulation by public authority, but feel that the line between public supervision and control on the one hand and business management on the other is the dead line across which officialdom cannot go without a challenge. The association believes that these bills overstep that limit.

Chairman A. R. Weed of the Massachusetts Gas and Electric Light Commission discussed public utility regulation briefly at a hearing in Boston March 12 in connection with the board's annual recommendations for legislation.

"I do not believe," said he, "that any public board

wants to meddle with the public service corporations where it is proper to keep hands off.

"I have heard a good many suggestions to the effect that the board ought to administer the law as it stands, confining itself to the important questions intrusted to it by the Legislature and not go out of its way to make suggestions that are outside and are paternalistic in their character. I do not believe it would be an efficient method of applying the remedy if, when we reached the point where a company should correct its ways, we had either to approach it by methods of publicity, primarily, or by a recommendation which we could not enforce. I think this is a remedy the virtue of which rests largely in the fact of possessing power. . . . I don't think, in fact, that you men realize the authority granted to the board with respect to rates, with respect to impairment of capital, to the supply of individual customers and other important questions. That power is of considerable importance, is more drastic and has less qualification about it and was earlier enacted than any other [regulative] law in the United States. . . . The power has been administered with moderation, and, I believe, on the whole, with reasonable justice. . . . If that confidence cannot be placed in the board, it is high time that some new arrangement was made."

STANDING COMMITTEES OF N. F. P. A. ELECTRICAL COMMITTEE

Personnel of Bodies Which Will Have General Direction of Recommendations for Changes of the National Electrical Code

In accordance with the newly adopted procedure of the electrical committee of the National Fire Protection Association the following standing committees have been appointed to have a general direction and supervision of investigations and recommendations for future changes and revisions of the National Electrical Code:

Cars and Railways. — M. Schreiber, chairman, Public Service Electric Company, Newark, N. J.; R. C. Bird, Ralph Sweetland.

Devices and Materials.—A. R. Small, chairman, Underwriters' Laboratories, 207 East Ohio Street, Chicago; H. R. Sargent, H. O. Lacount.

Fixtures, Heaters, Signs and Lamps. — J. C. Forsyth, chairman, New York Board of Fire Underwriters, 123 William Street, New York; G. E. Bruen, C. H. Lum.

Generating Stations and Substations. — A. M. Schoen, chairman, Southeastern Underwriters' Association, Atlanta; W. H. Blood, K. W. Adkins.

Grounding. — W. H. Blood, chairman, National Electric Light Association, 147 Milk Street, Boston; C. M. Goddard, H. S. Wynkoop.

Industrial Applications.—G. S. Lawler, chairman, Associated Factory Mutual Fire Insurance Companies, 31 Milk Street, Boston; F. Osgood, C. B. Langdon, J. M. Curtin.

Outside Wiring, Building Supply and Services. — M. G. Lloyd, chairman, Bureau of Standards, Washington; C. H. Hill, F. F. Burroughs.

Signal Systems, Wireless and Lightning. — W. S. Boyd, chairman, Western Association of Electrical Inspectors, Insurance Exchange, Chicago; A. M. Paddon, C. W. Mitchell.

Theaters, Moving Pictures, Places of Public Assembly and Garages. — Washington Devereux, chairman, Philadelphia Fire Underwriters' Association, 141 South Fourth Street, Philadelphia; V. H. Tousley, C. M. Tait.

Wiring Standards and Systems.—W. C. Peet, chairman, Peet & Powers, 70 East Forty-fifth Street, New York; Dana Pierce, F. Overbagh, R. P. Strong.

Suggestions for such changes should be sent to Dana Pierce, chairman of the electrical committee, 25 City Hall Place, New York, for reference to one or more these standing committees.

THE LIGHTING INDUSTRY DURING RECONSTRUCTION

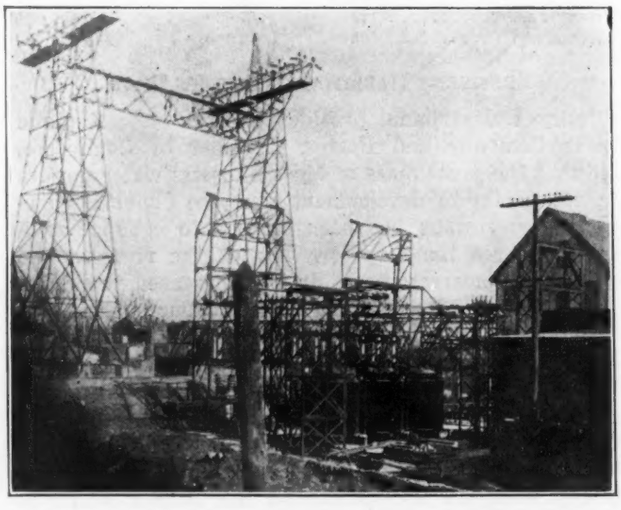
Definite Measurement of Intensities and Fixing of More Exact Requirements for Specific Kinds of Work Will Be Features

Two fundamental things which the men in the lighting industry should preach to the electrical trade and to the public during the coming year were explained by S. E. Doane, chief engineer of the National Lamp Works of the General Electric Company, Cleveland, before the Chicago Section of the Illuminating Engineering Society on March 20.

The first fundamental is that the foot-candle, which is the unit of light intensity, can be definitely and easily measured. The second deals with the lighting requirements for various classes of work. The speaker predicted that the intensities necessary for different jobs in all trades would become a matter of record in which the agreement as to values would be reasonably well accepted. As an instance of the beginning of this work, he cited the work of the Industrial Commission of Ohio in its proposed code of industrial lighting. In its present form this code devotes eight closely tabulated pages to data giving foot-candle intensities that should be employed in various classes of manufacturing.

Discussion of the address centered largely around the point that the Illuminating Engineering Society has not announced intensity standards which it is willing to declare are correct for use in different trades and various applications in the trades. J. N. Pierce, electrical contractor, pointed out that it would make the selling job of the trade very much easier if some national body would take the responsibility of announcing such data.

Outdoor Substation Replaces Steam Plant



At Westfield, Mass., a 500-kva. outdoor transformer installation is being completed by the Turners Falls Power & Electric Company, which supplies energy to the municipal lighting department of the town and to the Springfield Street Railway Company's local lines, formerly furnished by an 1800-kva. steam plant owned by the town and a 1000-kw. steam plant owned by the railway company.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

San Francisco Electrical Development League.—At the March 17 meeting of the league Charles Victor, Pacific Coast manager Yawman & Erbe, spoke on "The Personal Side of Scientific Salesmanship."

Trenton (N. J.) Engineers' Club.—On April 10 H. C. Eddy, senior inspector of traffic, Board of Public Utility Commissioners of New Jersey, will give an address on "The Development of the Electric Railway" at the meeting of the Trenton Engineers' Club, Trenton, N. J.

Public Utility Problems Presented to Board of Trade.—An interesting address on "The Problem of the Public Utility" was given by Ralph Elsman general manager of the Kings County Lighting Company, Brooklyn, N. Y., before the Gravesend Beach (N. Y.) Board of Trade on March 3.

Piezo Electricity Discussed in Syracuse.—At a joint meeting of the Syracuse Chemical Society and the Technology Club, Syracuse, N. Y., held on March 8, an illustrated talk on Piezo electricity, its development, uses, etc., was given by Alexander McL. Nicolson of the Western Electric Company, New York.

Engineers' Club of Philadelphia.—Morris L. Cooke is to speak on "The Participation of Engineers in Public Affairs" and Prof. George B. Pegram, dean of the School of Mines, Engineering and Chemistry, Columbia University, is to speak on "A Broader Type of Training for Engineers" at the Tuesday noon luncheons of the Engineers' Club of Philadelphia to be held on April 15 and 22.

Electrical Men of Buffalo Organize.—"The Electric Club of Buffalo" is the name of an organization recently formed in Buffalo, N. Y., "to encourage the more extensive use of electricity and to promote generally the welfare of the electrical industry." Among other things that the club will try to do will be urging the adoption of durable and efficient electrical devices and apparatus and their safe and proper installation. A feature of the organization is that each corporation, partnership and individual is entitled to only one vote regardless of how many men in a company are members of the organization. The club also intends to have meetings of a civic and educational nature. The first officers of the club are: President, L. A. Wooley; vice-president, L. E. Le Vee; secretary, H. H. Howell; treasurer R. Wahle.

A. I. and S. E. E., Philadelphia Section.—"Power Transmission" will be the subject of a talk by H. B. Vincent, operating engineer, Day & Zimmerman, Philadelphia, before the April 5 meeting of this section of the Association of Iron and State Electrical Engineers, to be held in the Engineers' Club.

Engineers' Society of Milwaukee.—J. R. Watson of Chicago gave a talk on "The Use of Synchronous Motors with Ammonia Compressors" at the March 19 meeting of this society, while Duncan Watson, M. I. E. E., a London alderman and chairman of the Joint Conference on Electrical Undertakings of Greater London, made a short address.

N. E. L. A., Power Sales Bureau.—A dinner will be held by the power sales bureau of the National Electric Light Association at Atlantic City during the week of the association's annual convention. John W. Meyer, Philadelphia Electric Company, chairman of the dinner committee, would like to be advised of the members' present business connections.

Employer and Employee Relations.—A joint meeting of the Chicago sections of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Western Society of Engineers, held on March 24, heard A. H. Young, manager of the industrial relations department, International Harvester Company, speak on the subject of "Industrial Personnel Relations."

I. E. S., Philadelphia Section.—On March 21 a paper entitled "Transmission of Colored Light Through Fog," prepared by C. L. Utterback, University of Washington State, was presented by Prof. Thomas D. Cope, University of Pennsylvania, who also discussed several of its phases. A paper will be presented at the April meeting of the section on "Some Practical Measurements of Daylight in Modern Factory Buildings," by E. G. Perrot and F. C. Vogan, of the architectural firm of Ballinger & Perrot.

American Institute of Electrical Engineers

Schenectady Section.—"Industrial Reëstablishment of War Cripples" was the subject of an address by Prof. F. H. Sexton, Nova Scotia Technical College, Halifax, N. S., given before the meeting held on March 21.

Lynn Section.—E. F. W. Alexanderson, consulting engineer, General Electric Company, lectured on "Transoceanic Radio Communication" at the March 26 meeting. A new radio system of the General Electric Company, known as the "Alexanderson system," was described in the lecture, which was illustrated by lantern slides.

Toronto Section.—Frank R. Ewart presented a paper entitled "Business Relations of the Engineer" at the meeting on Feb. 21. This section has opened a department in its employment office for the use of engineers and technical men returned from the front and desiring new business connections.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Valuation, Insurance and Depreciation.—The Railroad Commission of Wisconsin, in authorizing the Wisconsin Traction, Light, Heat & Power Company, Appleton, to increase electric rates, takes up also a number of other practices affecting operations. It says on several subsidiary points: "The utility contends that the value to be used at this time should at least be based upon the average cost of buildings, machinery, apparatus, material and wages during the past five years. During the present period of abnormally high prices the commission's engineers have adopted a ten-year average in determining unit costs in order to smooth out the price curve in those instances where the investment cost basis could not be used because of lack of adequate and reliable records. In the present case it is not believed that an appraisal at this time would show values materially different from those outlined above. . . . It appears clear that the consumers are now contributing through the rates charged an amount sufficient to enable the utility to carry insurance sufficient to cover every contingency which might arise. The utility, in order to protect not only itself but its customers, should, we believe, modify its present practice relative to carrying its own insurance on parts of its property. . . . The company, instead of reserving each year a percentage of the depreciable plant value based upon a composite life study, ignores such value entirely and sets aside a percentage of the gross revenues. This is a very convenient method used by a small number of utilities. It has the advantage of regulating the amount provided for depreciation in accordance with the gross income, but a reserve so provided may have no proper relation to the deterioration actually taking place in the property, because it is fixed entirely independently of the invested values. We have in this case based our allowances for depreciation upon the depreciable physical property used and useful. In the case of the electric light and power department of the utility this procedure results in a larger annual charge to operating expenses for this item than the utility's practice. In justice both to the consumers and to the utility, we believe that the utility should adjust its depreciation charges in line with the actual depreciable property."

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Water Power in Iceland.—United States Commercial Attaché Erwin W. Thompson, Copenhagen, Denmark, sends the following, taken from the Copenhagen *Berlingske Tidende:* "One of Norway's most prominent hydraulic engineers, G. Saetermoen of Christiania, recently made a speech in the Polytechnic Union in Christiania with regard to the building and utilization of water power in Iceland. Iceland is much better adapted than Norway for building water-power plants. The water-level variations are considerably less, the climate is more favorable, there are no ice difficulties, no fishing and no rafting of timber. Upon Norwegian initiative a new company has been formed under the name of "Titan" for building a series of power plants in Iceland. It is first the intention to utilize for electric power the Thorsaflod, which is Iceland's largest river. It has three tributaries running through southern Iceland with a total width of 5000 ft. to 8000 ft., and it has the most favorable development possibilities at proportionately small cost. The six power stations which are planned will together produce 1,114,000 hp., and the power can be delivered to Reykjavik just as cheaply as the Norwegian cities get their waterfall electricity.

Power Development in Sweden.—United States Consul General Albert Halstead writes from Stockholm, Sweden, that for the purpose of promoting greater efficiency in the operation of existing power stations in their district thirty-three of central Sweden's largest power producers have organized the Aktiebolaget Bergslagens (Combined Power Control), with a minimum capital of $402,000 and a maximum of $1,206,000. This company does not contemplate the erection of any new stations. It has found that the full production capacity of all stations at present in operation is not utilized, and it will aim, by a transfer of power from those stations capable of a greater output to those carrying too heavy a load, to make an equitable distribution. The Torpshammar Aktiebolaget is building at Torpshammar (Sundsvall) a new power station to develop 30,000 hp. The water-power commission, which was granted $2,200,000 for its work in 1918, has asked the government for an additional $268,000, to be used in making new purchases. The commission also has asked for $268,000 in 1919 and $670,000 in 1920, to be used in the construction of new power stations and in the improvement of stations already operating. Stations at Tyttbo and Umea are in view and extensive improvements at the Norrforsarna and Sorforsarna stations are among those planned.

Appliance Campaign at Cohoes, N. Y.—The Cohoes (N. Y.) Power & Light Corporation is about to open a display room and start an intensive campaign covering the sales of electric appliances.

National Electric System for Spain.—United States Consul General C. B. Hurst writes from Barcelona that a royal order published Dec. 31, 1918, provided that as soon as possible a permanent Spanish electric commission should be formed under the direction of the Ministry of Public Works. This commission is to report on the following points: (1) The possibility and practicability of the construction by the state, directly or indirectly, of a national system for the distribution of electric energy; (2) the maximum extension possible of such a system; (3) the approximate cost of such a system calculated on a basis of relatively normal prices, or with copper at between £70 and £80 per ton; (4) the possibility of the state supplying the capital to be thus employed or of guaranteeing its interest, taking tolls on the energy transmitted, and how much this toll should be, or any other means of financing the system deemed preferable; (5) the possibility of a uniform tension and the means to secure it; (6) the basis on which a law should be drawn up in connection with the foregoing. The director general of Spanish commerce, industry and labor states that it is of transcendent importance to Spanish industry that it avail itself of the electric energy that the country is capable of producing.

Re-education and Rehabilitation of Injured Employees.—A special committee has reported to the executive committee of the Empire State Gas & Electric Association on the re-education and rehabilitation of employees injured in industry. It is composed of J. C. Robinson, Ralph Elsman and C. E. Morrison, chairman. It expresses the belief that injured employees should be re-educated at least and perhaps rehabilitated at some central establishment organized for that purpose such as the Red Cross Institute for Crippled and Disabled Men, New York. The committee recommends that the public utility industry of New York State undertake this re-educational and rehabilitation work by arranging for a course of study at some central establishment, and that the necessary equipment be provided by the industry. This equipment might include the apparatus necessary for general training in both the gas and electrical industries. The committee also decidedly recommends the re-employment by the public utilities of their own disabled employees, provided they have successfully passed the requirements of the re-education instruction, and provided such employees are fully able to compete with others not handicapped by disability of any kind. The Federal Rehabilitation and Vocational Board, the committee understands, has suggested to some of the public utilities that they arrange to train, or educate industrially, injured sailors and soldiers, and that during the period of re-education the public utilities accept the burden of paying these sailors and soldiers a living wage. It is believed by the committee that the appropriations made by the government for this work were meant to include the maintenance during re-education of injured sailors and soldiers and that it is no function of the public utilities to assume this expense. The committee recommends, however, that the public utilities freely co-operate by permitting disabled soldiers and sailors to enter their plants for re-educational purposes, provided that no wage expense is attached thereto.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Muncipality's Relation to Rates.—Regulations regarding rates for gas which municipalities may impose in granting licenses or permission to use the streets to public service corporations do not form contracts beyond the inherent police power of the Legislature to modify, according to the Court of Appeals of New York (121 N.E. 777). Rate regulation being a matter of police power, the terms and conditions upon which a gas and electric company is allowed to use the streets of a municipality may be modified without impairing the obligation of a contract within the constitutional provision. Under the Public Service Commissions law, the state Public Service Commission has authority to regulate charges made by a gas company supplying the residents of a village.

Flowage Rights.—Where certain flowage rights appurtenant to plaintiff's lands were vested in plaintiff's grantor, but not conveyed with the fee to plaintiff nor with defendant's dam and factory sites, and according to the record remained in grantor, neither plaintiff nor defendant is possessed of the flowage appurtenant to plaintiff's land by grant, the Supreme Court of Michigan held in Murphy versus Big Rapids Water Power Company (170 N. W. 644). In a suit for mandatory injunction to compel defendant to lower a dam to prevent backing up water over plaintiff's springs, which he used for domestic purposes by means of a hydraulic ram, it was held that the relief alternative to lowering the dam should be a money consideration and not perpetual furnishing of energy for running a pump.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

H. E. Cox, formerly an engineer for the Birmingham Steel Products Company, has been appointed assistant to the chief engineer of the Birmingham (Ala.) Railway, Light & Power Company.

Barzillai G. Worth, vice-president and formerly electrical engineer of Walter Kidde & Company, Inc., has been elected treasurer of the Monmouth Chemical Company and will also be in charge of manufacturing and research.

Arthur V. D. Piper has been elected president and member of the board of directors of the subsidiary companies of the Central New Hampshire Power Company, Concord, N. H. Mr. Piper has been general counsel for the companies for some time.

H. H. Clark, formerly electrical engineer of the United States Bureau of Mines and during the war a major in the Chemical Warfare Service, has returned to civil life as chief engineer of the Witherbee Igniter Company of Springfield, Mass.

F. L. Cross, who has been elected president of the Minnesota State Electrical Association, has been associated with the public utility business in the Northwest for about ten years. From March, 1910, until November, 1917, he was vice-president and general manager of the Madison (Wis.) Gas & Electric Company. Since that time he has been vice-president and general manager of the St. Paul (Minn.) Gas Light Company, which is a combination electric and gas property.

Gen. Guy E. Tripp was recently decorated with the distinguished war service medal of the United States government, which was awarded him for his excellent work in systematizing methods and practice, resulting in the efficient coöperation of industries producing ordnance material for the army. He entered the army with the rank of colonel as chief of the production division of the Ordnance Department and was later promoted to the rank of brigadier general as assistant chief of ordnance. Before going into service General Tripp was president of the board of directors of the Westinghouse Electric & Manufacturing Company, to which position he returned after the signing of the armistice.

Guy C. Pierce will succeed W. E. Coman, whose resignation was announced in the ELECTRICAL WORLD of Feb. 15, as vice-president and general manager of the Northwestern Electric Company at Potland, Ore. Mr. Pierce has been identified with the electrical systems of the Pacific Coast for many years. In 1887 he was in the employ of the local electrical company at Sacramento, Cal., going later to San Francisco, where he had responsible charge of work in some of the pioneer power installations of the state. In 1901 he went to the City of Mexico to take charge of electrical properties for Pittsburgh interests. After remaining there for three years he went to New York and was for two years chief inspector for the Hudson & Manhattan Tunnel Company. From 1906 to 1909 he was identified with the East St. Louis & Suburban Railway Company, controlled by E. W. Clark & Company of Philadelphia. In 1909 and 1910 he was engaged in the development of the Mount Hood Railway & Power Company at Portland, Ore., which was later taken over by the Portland Railway, Light & Power Company. Mr. Pierce goes to Portland from Los Angeles, where he has been associated with R. C. Gillis in water-power development.

L. L. Newman, who was elected vice-president of the Birmingham (Ala.) Railway Light & Power Company, a little less than a year ago, has been named chief engineer of the company. He will devote practically all of his time to maintenance work. Mr. Newman prior to his appointment early in 1916 as assistant general manager of the company was superintendent of way and structures. Previous to his connection with the Birmingham property Mr. Newman was employed in various departments of the Pennsylvania Railroad.

Ira W. McConnell has become associated with Dwight P. Robinson & Company, Inc., constructing and consulting engineers, New York City, in the capacity of vice-president. Mr. McConnell was graduated from Cornell University in 1897 and for the next two years was instructor in the College of Civil Engineering at Cornell and for one year professor of Civil Engineering at the Missouri School of Mines. Mr. McConnell's experience includes six years in the United States Reclamation Service. In 1909 he became chief irrigation engineer for J. G. White & Company and later vice-president and general manager of the Idaho Irrigation Company at Richfield, Idaho. In February, 1912, he was employed by the Stone & Webster Engineering Corporation as consultant in connection with the design, construction and operation of public utilities, water powers, railways, steam-power stations, industrial buildings, etc. In 1916 he made a five months' study of general business conditions in South America, the trip covering the developed portions of Brazil, Uruguay, Paraguay, Argentina, Chile and Peru. In the following year he became chief engineer for Stone & Webster and later works manager and assistant general manager for the American Shipbuilding Corporation at the Hog Island shipyard.

J. K. Swanson, former secretary of the Michigan Power Company and assistant secretary of the Consumers' Power Company, has been appointed successor to B. R. Laraway as manager of the Jackson (Mich.) district of the Consumers' Power Company.

W. I. Bickford, who was elected chairman of the Atlantic division of the Electrical Supply Jobbers' Association at the recent meeting in New York City, has been secretary-treasurer of the Iron City Electric Company, Pittsburgh, Pa., since its organization in 1907. Mr. Bickford was born in Washington, D. C., Nov. 13, 1879. He attended Phillips-Exeter Academy and in 1901 was graduated in electrical engineering from the Massachusetts Institute of Technology. During the following school year he was an assistant instructor in the department of electrical engineering and physics at the institute. He then became electrical engineer in the office of the supervising architct of the Treasury Department at Washington and in 1903 became associated with the Iron City Engineering Company, Pittsburgh. In September, 1904, he became secretary-treasurer of the company. Mr. Bickford is a member of a number of prominent Pittsburgh business and social societies and for the past two years has been a member of the executive committee of the Electrical Supply Jobbers' Association.

Obituary

Charles T. Jaeger, one of the pioneers of the miniature incandescent-lamp industry, died recently at his home in Brooklyn, N. Y., from pneumonia. Mr. Jaeger retired from active business about five years ago. He was a brother of Herman J. Jaeger, of the H. J. Jaeger Company, Weehawken, N. J.

Thomas Bentley Hardin of the law firm of Hardin & Hess died March 12 at Phoenix, Ariz. Mr. Hardin was considered an authority on corporation and public utility law. From 1888 to 1907 he was in practice at Seattle, Wash., being a law partner of James Hamilton Lewis, now a United States Senator from Illinois.

Dr. James J. Clark, a pioneer in the development of telegraph devices and a contemporary of Samuel Morse and Alfred Vail, died in Washington, D. C., on March 21 at the age of ninety years. At the time of his death Dr. Clark was probably the oldest pioneer in the telegraph industry. He entered the industry in the forties. He was a builder of telegraph instruments in Philadelphia in the early days. He also built telegraph lines and at the outbreak of the Civil War connected the War, Navy and other government departments by wire. Prior to that all communication between these departments had been by courier. Dr. Clark invented the first successful cloud-circuit repeater, which with slight changes from the first design is still in use.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

BUILDING EXPECTED TO OPEN UP BEFORE LONG

Cut in Steel Prices Should Hasten Contracts—Except for Conduit, Lower Prices in Electrical Materials Not Anticipated

Cuts in steel prices last week are expected to prepare the way for a resumption of building. Structural steel is lower and pipe is expected to follow almost immediately. Moreover, the cuts have been sufficient to warrant the expectation of lower prices on tools, hardware, heating and plumbing iron and steelware.

Should the expected lower prices of building materials bring any considerable volume of construction, the electrical trade will naturally benefit. However, it must be remembered that orders for electrical material are among the last to be placed. For that reason even if building began on a large scale in April the electrical trade would hardly be expected to feel it before July or later.

There is this satisfaction, however. Manufacturers and jobbers will know sufficiently well ahead what is expected of them and consequently will be in a position to make favorable quotations and deliveries without injury to stocks.

It seems doubtful that electrical building materials will go much lower. Wire, with the exception of a few concerns, has followed the price of copper downward rather consistently. Copper appears to be at about as low a level as it will reach this year. In fact, it would not be surprising to see copper 2 cents to 3 cents higher before the end of the summer. Schedule material, however, shows no signs of coming down.

Rigid conduit, following the announcement of the steel cut, came down five points, and flexible metallic conductor is off this week $10 per 1000 ft.

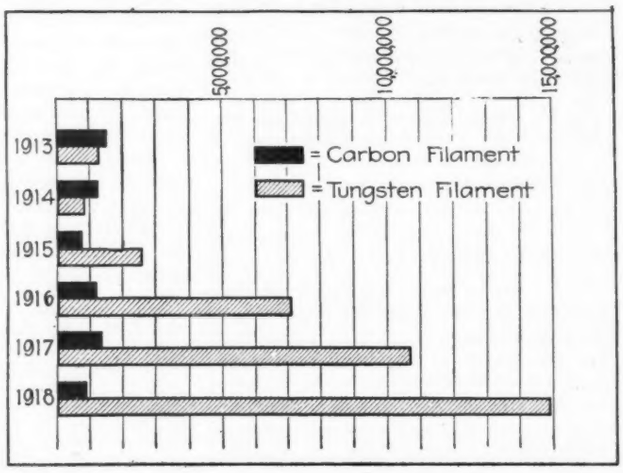
ANALYSIS OF EXPORTS OF INCANDESCENT LAMPS

In Six Years the Number of Lamps Exported Has Increased Over Ten Times—Still Large Unfilled Market

Exports of electrical goods have grown rapidly in the last six years, particularly exports of incandescent lamps. An analysis of the growth of the foreign demand for this commodity has been made by the ELECTRICAL WORLD. As will be noted from the chart, the exports of carbon lamps have been virtually the same year in and year out, while the exports of metal-filament lamps, with the exception of a slump in 1914 when the war began, are rapidly mounting. The figures as shown in the accompanying table give the number of metal-filament lamps exported annually, classified according to world geographic divisions. In each case the year has been taken as the fiscal year ended June 30. For 1913 the total is 1,363,493 lamps; it was 849,261 in 1914, 2,509,849 in 1915, 7,670,868 in 1916, 10,703,531 in 1917, and 14,855,849 in 1918.

It is evident, however, from a study of these figures that the foreign market for lamps is almost exclusively in North and South America. Thus 76 per cent of the lamps exported went to this hemisphere in 1913, 81 per cent in 1914, 64 per cent in 1915, 54 per cent in 1916, 84 per cent in 1917, and 87 per cent in 1918.

It is interesting to note how the war affected the Canadian demand for American lamps. Starting out in 1913 Canada took but 7 per cent of this country's exports of metal-filament lamps, or 95,864 lamps. It took 9 per cent in 1914, or 75,568 lamps; 9 per cent again in 1915, or 220,452 lamps; 7 per cent in 1916, or 537,403 lamps; 18 per cent in 1917, or 1,894,913 lamps, and 22 per cent in



GROWTH IN NUMBER OF INCANDESCENT LAMP EXPORTS DURING PAST SIX FISCAL YEARS

1918, or 3,261,113 lamps, thus becoming the foremost export customer in this market.

In South America Argentina and Brazil are the largest markets. Combined they imported American metal-filament lamps as follows: 1913, 336,977 lamps; 1914, 128,380 lamps; 1915, 510,748 lamps; 1916, 1,338,226 lamps; 1917, 3,758,884 lamps, and 1918, 4,266,086 lamps. These two republics absorbed 67 per cent of all American lamps going into South America in 1913, 53 per cent in 1914, 72 per cent in 1915, 71 per cent in 1916, 92 per cent in 1917, and 68 per cent in 1918.

There is, however, a large foreign demand that is not being met by American lamp manufacturers. As far back as 1912, for instance, Germany exported (exports to United States excluded) lamps to the value of $12,700,000, or, at an average of 30 cents per lamp, 42,000,000 lamps. Germany's largest customers in that year, on the same basis of 30 cents per lamp, were: Italy, 3,200,000 lamps; Spain, 2,400,000 lamps; Argentina, 1,500,000 lamps; Brazil, 1,400,000 lamps; Great Britain, 5,500,000 lamps; Austria-Hungary, 3,600,000 lamps; France, 2,300,000 lamps; Russia, 8,600,000 lamps, and Belgium, 1,800,000 lamps.

NUMBER OF METAL-FILAMENT INCANDESCENT LAMPS EXPORTED DURING LAST SIX FISCAL YEARS— CLASSIFIED GEOGRAPHICALLY

	1913	1914	1915	1916	1917	1918
Europe	36,599	18,126	447,300	1,923,881	285,655	194,675
North America	513,244	442,603	894,441	2,287,692	4,863,947	6,720,023
South America	519,895	243,938	706,477	1,884,339	4,105,591	6,249,516
Asia	10,408	14,198	191,477	517,926	599,335	373,089
Oceania	190,650	96,551	150,218	618,894	663,984	891,462
Africa	92,697	33,845	119,936	438,136	185,019	427,084
Total	1,363,493	849,261	2,509,849	7,670,868	10,703,531	14,855,849

Great Britain in 1912, on the basis of 30 cents per lamp, exported about 1,000,000 lamps. No returns were available from Holland or from Austria-Hungary.

Nevertheless, it is apparent that a large foreign demand

remains unfilled. England was not able to make large exports during the war, and the Central Empires, except for contiguous territory, made none. Holland did a large business during the war in Europe, particularly with England. Japan did some business and is fast becoming a factor in the incandescent-lamp market. There is, however, considerable American capital invested in Japanese lamp production. Such production, the impression exists, will be devoted almost exclusively to supplying the Far Eastern demand in Russia, Japan, China and perhaps Australia and nearby markets.

English lamp manufacturers are for making a bid not only to supply the domestic market but also to enter foreign markets to a larger degree. Owing to domestic conditions, however, it seems doubtful that English manufacturers will become a large factor in foreign markets at the present time.

The United States used to import large numbers of lamps, but, owing to the ability to diminish production costs, it was possible as early as 1914 to compete with foreign lamps on a price basis. Since that time patent infringement has served to prevent any large quantity of foreign tungsten-filament lamps being imported.

METAL MARKET SITUATION

Steel Prices for the Year Stabilized—Copper Market Has Grown Stronger

With the strongly expressed opinion of many steel producers that at this time there should be either a large reduction in steel prices, one that would command the interest of the long-range buyer, or none at all, there comes the news that an average reduction of about $7 per net ton will fit grooved-steel skelp and wire products and $5 per net ton will fit everything else. The Industrial Board stated that the public should not expect to buy below the reduced prices during the present year.

There has been a decided change for the better in the copper market. The sales for March 22 and 24 totaled 35,000,000 lb., or better than either January or February, and if the major part of the inquiries now in the market are closed before the end of March, the total transactions for March alone would be about 100,000,000 lb., or more than the combined sales from Nov. 11 to Feb. 28. Apparently the turn has been reached, for the market price is advancing and is quoted at 15.25 cents per pound. Last week it was 14.87½ cents.

Aluminum has dropped off a cent and sheet zinc a cent, while copper at London has advanced £1. Scrap lead has dropped about ½ cent and scrap zinc about the same, but the old-metal market has continued in its quiet state.

NEW YORK METAL MARKET PRICES

	March 18	March 25
Copper:	£ s d	£ s d
London, standard spot	77 0 0	78 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	15.25 to 15.50	15.25 to 15.50
Electrolytic	14.87½	15.25
Casting	14.75	14.87½
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.25	5.25
Antimony	6.90	6.62½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	10.00
Spelter, spot	6.50	6.52½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	30.00	29.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	12.75 to 13.25	12.75 to 13.00
Brass, heavy	7.25 to 7.50	7.25 to 7.50
Brass, light	6.00 to 6.25	6.00 to 6.25
Lead, heavy	4.75 to 4.87½	4.25 to 4.50
Zinc, old scrap	4.50 to 4.75	4.00 to 4.50

THE WEEK
IN TRADE

THE last of the winter months is gone, and the industry faces spring in excellent condition. Building is opening up, in a small way to be sure, but definitely. Lower steel prices and dropping materia' costs predicate the coming of larger building.

Prices of conduit, metallic flexible conductor and wire are lower. It appears evident, however, that the latter has about reached its lower limit, at least for some time.

Collections are holding up well, and with a continuance of good retail business and a promise of work building should be better.

NEW YORK

With the recent action of the industrial board of the Department of Commerce and the representatives of the steel industry, wherein the price of steel for building construction, among other steel products, was reduced, there is manifest hope that consideration will soon be given to other materials of building construction, with the result that there will be lower prices all along the line. The declines so far have been of such a nature that there is expected to result a moderate amount of transient business, covering requirements that could hardly be postponed. These lower prices merely tend to stabilize the market and establish a minimum which is likely to prevail during the 1919 building season.

During the week ended March 15 contracts were placed in the metropolitan district for a total of 167 projects, representing an expenditure of practically $5,500,000, as compared with 112 operations, for $3,000,000, placed the week before.

Labor disturbances are fewer this week than they have been in some time.

Several refrigeration projects have just come through, and it is expected that they will be in operation about the first of July. Central stations have withdrawn some of the restrictions placed on extensions of lines, but as yet there has been little advantage taken of this commercially either for power or lighting purposes. Increase in watt-hour meter sales has not been marked, but a small market has been noticed for power transformers and regulators.

Jobbers have reported March so far as a rather good month. Their collections have been good both from contractors and dealers and are keeping pretty well under sixty days.

USED APPARATUS.—One large dealer states that, although inquiries have fallen off, orders have become better. Most of the equipment is for use on central-station lines rather than on isolated lines. His experience with motors bought by the government for war work is that the government is holding many of these motors for future use. Another large dealer reports the used market very quiet and finds that in some cases the government is using motors in part settlement to the industrial concerns where they were used. This equipment has been written off at a low percentage of its original cost.

TRANSFORMERS.—An increase in demand for power transformers of all sizes has been reported by one large manufacturer. These are for both central stations and industrial plants. Inquiries in another case bring no appreciable increase in demand. Deliveries are becoming much better.

FEEDER REGULATION.—There has been reported an increased demand for this type of apparatus.

SWITCHBOARD EQUIPMENT.—A much improved market has been reported for panelboards and equipment, and especially oil switches. This is in a large part for converting and replenishing industrial plants.

IRON CONDUIT.—Since the change in steel prices rigid conduit has eased off five points.

NON-METALLIC FLEXIBLE CONDUIT.—Discounts have changed from 60 per cent to 70 per cent, making a reduction in price of 25 per cent.

LAMP CORD.—Some very large orders have recently been placed, presumably for socket devices.

POWER CABLE. — With the exception of Hartford, Conn., which is ordering cable for street lighting, there is little activity in this section for power cable. Cincinnati, however, has just placed a large order for use in street lighting, and Chicago and Niagara Falls have ordered cable for power puproses.

CRANES.—Prices on overhead electric cranes have been reported down 20 to 33⅓ per cent, and in one case 50 per cent.

FLEXIBLE METALLIC CONDUCTOR.—Prices were reported on Monday to be down $10 per 1000 ft.

WIRE.—Rubber-covered wire base is still on 20 cents. One manufacturer went to 18 cents this week, which is the lowest mark wire has yet hit. Another producer, however, stiffened his base from 20 cents to 22 cents. Present indications are that wire has gone about as low as it will do for some time.

CHICAGO

A climax appears to have been reached in the market situation. Up to the present time practically all Chicago jobbing houses have had more persons than usual in the departments devoted to answering inquiries, and these departments have been further behind than ever. The trouble has been that not a sufficiently large percentage of these inquiries developed into business. Indications this week are that the market has turned the corner and that estimating will now give way to buying. Observers who have made this decision arrive at it on the basis of two facts—first, the steel price situation has been definitely settled, and, second, buyers who have been watching the copper market very closely for the last three weeks have closed orders. In regard to the steel price there is a divided opinion among the jobbers as to the effect on the electrical business. Some think it will help the situation wonderfully; that conduit will of course decline somewhat, but that the real effect will be brought about more by the stabilizing influence of the decision than by any change in price. Others would like to have seen the price decrease from 20 to 25 per cent with assurance that it would hold for a longer period than that stated in the present understanding. It is agreed that line hardware will probably go from 10 to 15 per cent lower, but this is not a large item, inasmuch as a 10 or 15 per cent change in the price of hardware does not make a big change in the price of a line. There have been a number of price changes during the week. The building outlook in Chicago continues to be bright, if one may judge from the columns of the newspapers. Ground will be broken in June for a new hotel on Chicago's north side to cost $4,500,000. The American Association of Engineers is endeavoring to promote the building of a ten-million-dollar memorial building in the city. Building permits for the week increased to $1,370,000 against last week's figure of $500,000.

Further information regarding the building program for grain elevators for 1919 gives more specific information as to the amount of electrical material which will be required for this work. Of the large type of elevators seventy-five are scheduled to be built in 1919. A typical design for such an elevator includes forty-seven motors ranging in size from 3 hp. to 100 hp. There are in such an installation 1081 outlets.

COPPER WIRE.—The Chicago City Railways Company this week purchased 97 miles of three-line No. 0 trolley wire from the Central Electric Company of Chicago. The base of both rubber-covered and weatherproof copper wire in Chicago has remained at 20 cents.

HIGH-TENSION PORCELAIN.—The market for high-tension porcelain is steady, and it seems improbable that there will be price decreases in the near future. High-tension insulators are usually made up in quantities at the factories during the winter months to supply the spring demand. This course was followed during the past winter, and the present stocks are those which are made up under high cost conditions. It seems improbable that prices will decrease until these stocks have been entirely cleared out, and they may not even decrease then, as the labor situation in the porcelain centers is reported not to have improved.

STANDARD PORCELAIN.—There has been a decrease in price of about 25 per cent in standard porcelain.

BOXES AND BUSHINGS.—There has been a decrease in price of 15 to 20 per cent affecting boxes and bushings.

CONDUIT.—Non-metallic flexible conduit has decreased 25 per cent in price.

APPLIANCES.—The general appliance market continues to exhibit a strong demand with supply maintained in a desirable manner.

BOSTON

The volume of trade is well maintained, despite the slow development of new business projects. Stocks are beginning to get "spotty," owing to the hand-to-mouth purchases of jobbers. Inquiries are coming in faster, and central-station outputs are holding up exceedingly well. Collections are fairly good this week. Great interest in electrical accessories was displayed at the Boston automobile show this week, and a banner year is anticipated by distributers. Prices weakened about 25 per cent last week in circular loom, and bare copper-wire quotations reflect recent downward tendencies. Domestic appliances are moving rapidly, and an excellent response is noted to house-wiring campaign efforts now under way. Retail business appears quite active. Considerable interest is being shown in small water-power facilities throughout New England. In the electrical industry labor conditions are freer from serious disturbance than for some time. Electrical manufacturers report raw material plentiful. Non-employment exists to an unfortunate extent, but this is in part due to the desire of returning soldiers and sailors to obtain new jobs in place of their former posts.

CIRCULAR LOOM.—Current quotations show a drop of about 25 per cent in the past week. The maximum discount quoted is now about 66 per cent. Prices of $\frac{7}{32}$-in. and ¼-in. loom fell to $15.50 and $18 per 1000 ft. respectively.

CONDUIT.—Prices still hold without much change, but jobbers with sizable stocks fear that some losses will have to be borne in the near future if the expected reduction through the government steel price standardization materializes. Stocks are irregular, and the demand is small.

MOTORS.—Stocks are accumulating and inquiries are in fair volume. Prices are steady for the most part, though the temptation to shade quotations under close competition is very strong just now. Some revival of business in the textile field gives ground to anticipate a better movement of motors here before long.

ELECTRIC AUTOMOBILES.—The demand is excellent and prices appear to have little effect on the market. A prominent dealer reports inability to obtain sufficiently prompt deliveries from the factory. Not all distributers adopted the recent price advances quoted by sales agencies in other parts of New England. It is said that these advances were not increases established at the factories but were due to increased overhead costs in distribution combined with an inadequate supply of cars.

STORAGE BATTERIES.—A heavy demand for automobile service is reported, with steady prices throughout the past week. A shortage of wooden separator material and rubber-jar stock is conceded in some quarters.

WIRE.—Rubber-covered base price this week is 21 cents; weatherproof, 18¼ cents, and bare, 17½ cents. Inquiries are increasing and deliveries are excellent. It is felt that prices are close to the minimum.

ELECTRIC RANGES.—Inquiries are increasing and some orders are being handled by distributers. Stocks are good.

SCHEDULE MATERIAL.—Local stocks are in good volume. No early price changes are anticipated. Small

orders are increasing in number, and improved business is being enjoyed here and there by contractors.

SIGNS.—Business is increasing materially. The high cost of labor is keeping prices high, but an increased advertising outlay is calling for a good deal of electric sign work. The shortage of miniature and sign lamps lately reported has been generally overcome.

INDUSTRIAL ELECTRIC TRUCKS.—Government business has been considerably curtailed by the failure of the naval appropriation bill at the last Congressional session. Prices are likely to reflect recent reductions on storage batteries within a few days.

ATLANTA

Government reports show that Atlanta is short approximately 2500 homes, and the present realty activity, together with the increasing number of building permits, points to a return of normal conditions. This condition holds true in other Southern industrial centers. A few cities show a surplus of labor. The railway clerks' strike continues, and incoming and outgoing freight commitments are demoralized.

VACUUM CLEANERS.—Although trade has been very satisfactory during the past three months, dealers and jobbers report increased activity this week, and all types and sizes are moving briskly. Anticipating a period of heavy buying during the early spring months, jobbers have placed substantial orders and shipments are arriving in sufficient volume to handle the present demand.

WASHING MACHINES.—Jobbers' and retailers' sales show a marked improvement this week. On the whole business has been good, but present activity indicates an increase in the volume of transactions. The trade is especially optimistic in regard to future sales, and large orders are being placed. One feature of note is the activity of certain jobbers in going after the rural business created by farm-lighting outfits. There is no doubt that this year will witness a heavy sale of washing machines of all types.

LAMPS.—The volume of sales shows a slight decrease, but not so great when compared with the previous year. In fact, dollar value is in excess. Although cantonments and shipbuilding plants have curtailed their purchases, ordinary commercial channels, and especially the lumber industry, have increased their requirements, and a higher general average is maintained. The manufacturers have become very active since all restrictions have been off, and all territories will be well covered in the next few months by local dealers. The demand for miniature lamps has exceeded all expectations, and manufacturers are exerting every effort to increase production, which is reflected in shorter shipments. While the call remains insistent, distributers are getting in better shape each day to handle the volume of business.

FARM-LIGHTING OUTFITS.—Despite the entry into this market of new companies, the aggregate volume of transactions is growing by leaps and bounds, and apparently every one is obtaining as much business as can be handled. The sale of this equipment opens up a wide market for supplies, fixtures and socket appliances, and a number of dealers are taking the opportunity of laying in stocks of such goods. The market for lighting outfits in the Southeast has hardly been "scratched." Shipments on certain sizes are coming through much better.

CREDITS AND COLLECTIONS.—Manufacturers' collections are good and compare favorably with the corresponding period in February. There is no increase in jobbers' paper, and receipts from this quarter are well up to the required standard. Accounts with a few of the larger utilities are somewhat sluggish. The much-looked-for liquidation on account of cotton holding has not materialized, and surface indications are that all current indebtedness is being satisfactorily taken care of. While sentiment in certain quarters is opposed to the so-called "cotton-holding" program, it must not be overlooked that, at least for the present, the electrical interests of the Southeast are tied up indirectly with the success or failure of this movement. Contractors, dealers and retailers have experienced a profitable year and their accounts through jobbers are in satisfactory shape.

SEATTLE—PORTLAND

Seattle jobbers as a whole report that the volume of business during the week shows a decided increase over the week before, due primarily to resumption of activities in shipyards. It is believed that from now on sales volumes, both wholesale and retail, will show gradual increases. Retailers report an increasing demand for fixtures and household appliances, particularly irons, washing machines and sewing machines. Range sales show an increase over last month. Generally speaking, stocks are in excellent condition. There has been no recent change in prices.

Unusual activity in the construction of small homes to meet housing needs in the Puget Sound district is noted, although there is a tendency to wait for a reduction in costs. An increasing interest in Puget Sound cities' industrial future is found in inquiries relating to sites and the possibilities of financing new industries, particularly tools and machinery. Eastern Washington and Oregon farmers are reported to be having a hard time to secure competent help, and with the actual beginning of spring work at hand the situation is causing considerable concern.

The Portland district reports that the general industrial situation remains practically unchanged as compared with the past week. The volume of sales shows no decrease. There were no large sales reported, although several are pending awaiting the definite settlement of labor troubles. The chaotic conditions which have obtained in the Northwest since the signing of the armistice are gradually disappearing with the end of shipyard strikes, reopening of mills, camps and certain industrial institutions and the prevalent spring weather. Retailers in Portland report business as good, in fact beyond what was really expected. Building activities are not yet very strong, being confined principally to residences and repairs, although a few concrete buildings, either garages or industrial structures, are under erection.

SAN FRANCISCO

Realty business in San Francisco and Bay cities during the week was small. Several sales in widely separated sections indicate, however, that the investment element is watching the market. There is a big demand for homes, and the rents remain high. The architects have a lot of construction work laid out waiting for the people with the capital to instruct them to proceed. However, there have been at least six fair-sized apartment houses started during the past week.

The war-time rates on electricity which were allotted the power companies last June will probably be discontinued by order of the State Railroad Commission unless the different companies are able to show that abnormal conditions still exist. The companies have been called to appear before the commission on April 29. The commission last June authorized a surcharge of 1 cent a kilowatt-hour on all energy sold for lighting purposes and 0.2 cent a kilowatt-hour for power purposes.

FARM-LINE TELEPHONES.—The farmers have done no real construction of telephone lines for the last three years. As a result of a good rainy season and the assurance of good crops and large profits, the farmers are ready to make improvements. The sale of telephones and associated material has been excellent this year and will probably continue so for several months.

FARM-LIGHTING PLANTS.—There is a wonderful demand for these plants. One dealer in Fresno purchased a carload of plants and has prospective purchasers for all of them.

INTERPHONES.—The demand in the last two years has been from industrial plants, a large number of which had come into existence during that period. As the demand from that source will now drop off, sales are now looked for from apartment houses, hotels and large residences, and the electrical dealer is combing that field.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
¾	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00	$20.00	$18.00
½-in.—	30.00	24.00	21.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–26.50
½-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 12.1%	9% to 14.1%
2500 to 5000 lb.	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg.	7.00

Standard packages, 500. List each, $0.07

LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18
Coil to 1000 ft	28.60

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $17.00
1/5 to std. pkg	12.00 to 14.00
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00–$24.15
1/5 to std. pkg	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$16.00	$22.00
1/5 to std. pkg	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-qmp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
0-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to list
1/5 to std. pkg	+5% to 10%
Std. pkg	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41
No. 18, full spools	.39

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$20.20	18.18	$15.15
10	27.00	24.30	19.44
8	33.12	30.36	26.50
6	52.50	48.13	42.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00–$20.00	$13.00–$15.00	$11.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$26.75
25 to 50 lb	26.75
50 to 100 lb	25.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $25.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.25

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

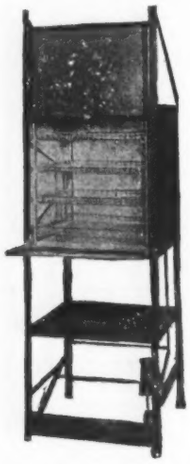
Electric Sign Without Wiring

The customary wiring and bushing arrangement for electric signs has been replaced by slots formed of two pieces of angle iron in the interchangeable-letter bulletin being marketed by W. F. Keckeisen, 1644 First National Bank Building, Chicago. Into these slots are inserted the porcelain blocks, one for each letter to be used. Contact is completed with the letters through pins inserted into contact points in the porcelain blocks. Because of this elimininations of wiring and bushings it is said that one-third less material is required for this type of sign than for a standard interchangeable-letter sign of the same size. Less labor is required for making the sign, and the erection may be accomplished by one man.

Electrically Heated Roll Warmer

While designed primarily for keeping rolls warm and fresh, the warmer recently developed by the Duparquet, Huot & Moneuse Company of 108 West Twenty-second Street, New York City, should find extensive use as a food warmer, the makers say, owing to the small amount of energy consumed and the efficient arrangement for supplying moist heat.

Water in a tank connected to the house water supply or filled by hand as required is evaporated by an electric heating element, and the moist heat is



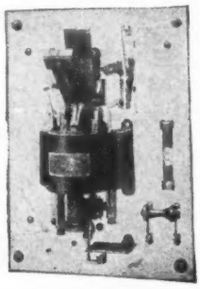
UPPER SECTION OF DOOR SLIDES UP, WHILE LOWER SECTION DROPS DOWN

automatically supplied by a sight feed device which shows the amount of water being supplied at all times. A 300-watt General Electric sheathed-wire unit placed on each side of the roll compartment allows free circulation of the heated air. Energy may be obtained from the usual lighting circuit and is controlled by a switch mounted on the warmer with an indicating pilot light.

An interesting feature of this warmer is the self-closing door, which is made in two sections, the upper part sliding up while the lower portion drops down and forms a shelf upon which the bread tray may be set. The door-opening device consists of an arrangement of levers actuated by a foot bar extending across the front of the warmer and placed flush with the front. An adjustable air cushion is also provided to prevent doors from closing too rapidly. Pulleys, chains and counterweight are eliminated by this arrangement.

Adjustable Automatic Reclosing Circuit Breakers

Three additional types of automatic reclosing circuit breakers manufactured by the Automatic Reclosing Circuit



HAS SOLID COPPER CONTACTS AND CARBON TIPS

Breaker Company of Columbus, Ohio, are provided with overload, dead-load and time-interval adjustments. The dash pots by which the time for the breakers to remain open is regulated are of the bellows type and can be adjusted for any time interval from a half second to five minutes or more Types ARL and DRL breakers are furnished with laminated brush contacts and auxiliary copper contact tips and "graphaloy" arcing tips, while type CRL is supplied with solid copper contacts which make a sliding contact and with "graphaloy" arcing tips on the front contact arm. The ampere ratings of the breakers range from 25 to 2000; overload calibrations have minimums of from 15 amp. to 1200 amp. and maximums of 50 amp. to 3600 amp., while the entire three types are procurable in 110, 250 and 600-volt sizes.

Sockets with Detachable Push-Buttons

Installing push-button sockets in husks, socket covers and other restricted locations often entails considerable time on account of awkward positions. The Bryant Electric Company of Bridgeport, Conn., which makes

BASES AND RECEPTACLES ARE INTERCHANGEABLE

the "Wrinklet" line of interchangeable lamp receptacles and sockets, has improved the push-button socket designated as No. 81 by making both buttons detachable. This is accomplished by molding a threaded stud laterally into each of the buttons, the stud in the black or "off" button being of a larger diameter and a different thread from the stud molded in the red or "on" button. This feature prevents transposition of the two buttons after the socket has been inserted in the fixture.

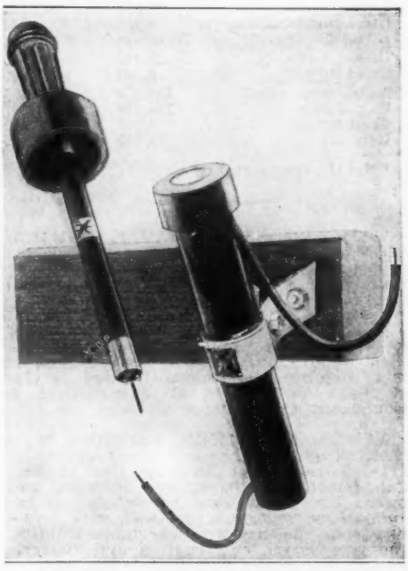
Ejector Cut-out for Transformer Protection

A special fuse, a handle and a housing are the essential parts of an ejector cut-out now manufactured by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, for protecting transformers. Among the features claimed by the manufacturers of this device are that it is thoroughly safeguarded against corrosion induced either by the atmosphere or by gases, that the operator may inspect and handle it with safety, that an indicator shows whether the cut-out is in operating condition or whether the fuse has blown, that it is easily re-fused, since linemen can conveniently carry extra fuse tubes to be inserted in the housing, and that the space occupied is quite small, as 3½ in. (8 cm.) is the total length of cross-arm required. The cut-out is 16 in. (40 cm.) high, and is mounted at an angle of 30 deg. from the vertical for convenience in handling.

The handle of this device not only provides a means for inserting and re-

moving the fuse but also acts as a cover to the whole unit, fitting down over the top of the main housing to exclude water, snow and sleet. The leads furnished with the cut-out pass directly through openings in the main housing and fasten securely to the internal contacts, so that there are no terminals or other line parts that can be touched by the operator during normal operation. A supporting clamp, made of hot galvanized steel, is fitted around the cut-out for mounting on the cross-arms.

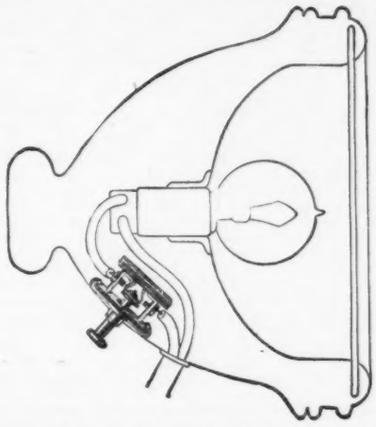
The fuse proper consists of a "Bakelite" tube, inside of which is a high-tensile-strength, high-resistance, fusible link, held under tension by a coil spring fastened into the base of the fuse tube. This link is shunted by the fuse element proper, and the latter is therefore not subject to any tensile strain. The fuse element is inclosed in a cork, and this is in turn inclosed in the fuse tube. The fuse tube screws directly into the cut-out handle, making a rigid unit of these parts. The current is conveyed from the base of the fuse to the fusible link through flexible copper cables shunting the coil spring, so that the current traveling through the spring is negligible.



CONDITION OF FUSE VISUALLY INDICATED

Switch Mounted Inside of Spotlight Shell

One of the recent developments of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is a push-and-pull spotlight switch made for mounting within the shell of the light. According to the maker, a satisfactory automobile lighting switch must have large "wiping" contact surfaces to prevent excessive contact resistance, and the contactor must "float" on the operating shaft in order that vibration and side strain on the button shall not cause the light to flicker. Both of these features have therefore been incorporated in this switch. Its insulating parts are made of fiber, the frame of stamped steel, the contacts of brass, and the contactor of phosphor bronze. These parts are riveted together into one solid unit which, it is stated, does not loosen or change alignment when subjected to vibration or strain. The switch mechanism is not inclosed because it is installed inside of the spotlight shell with only the button protruding. Either rivets or machine screws can be used to fasten the switch to the shell, and no plate is required, since drilling one hole for the button and two for the rivets or screws permits mounting the switch as shown in the accompanying illustration.



NO VIBRATION OR SIDE STRAIN ON BUTTON TO CAUSE FLICKERING OF LIGHT

Auxiliary Hoist for Traveling Cranes

Cranes for lifting heavy loads are usually slow-moving, and their use results in a loss of time when handling light loads which often constitutes a considerable part of the day's work. Moreover, there is a power loss when large cranes are used for light-load manipulation, since the hook and block themselves have an appreciable weight. To overcome these drawbacks N. B. Payne & Company, 25 Church Street, New York City, have recently developed an auxiliary hoist for attachment to any overhead traveling crane, which will handle light loads at a higher speed than that of the main hoist. This auxiliary hoist does not require an extra trolley, does not shorten the travel of the trolley on the bridge, and does not take up any additional room overhead nor interfere with accessibility of the main hoist. It is pointed out by the makers of this auxiliary hoist that by its application a standard single-hoist electric traveling crane may be equipped with two lines for drop-bucket service. Ordinarily these auxiliary hoists are supplied by the makers in from 1-ton to 5-ton sizes, but larger special sizes may also be obtained. Control may be arranged from cage, floor or pulpit according to the crane upon which the hoist is appplied.

DOES NOT INTERFERE WITH OPERATION OF MAIN HOIST

NOTES ON RECENT APPLIANCES

Vacuum Cleaners

The Jewel Electric Company, 4714 Broadway, Chicago, is making two new electric vacuum cleaners, known as the "Quaker" and the "Jewel."

Linotype-Metal Feeder and Pot Heater

Electric metal feeders and pot heaters for linotype machines have been developed by the Fort-ified Manufacturing Company of Kansas City, Mo.

Power-Factor Meter

For power survey work and tests on motors the Esterline Company of Indianapolis, Ind., has recently brought out a portable graphic recording power-factor meter.

Wire-Braiding Machine

A machine for braiding a covering over wire, which is said to be operated on a new principle, is being made by the Wardwell Braiding Machine Company, Central Falls, R. I.

Motor-Driven Controller

For use with fire-alarm sirens, signal lights, searchlamps, whistles and other special applications the Reynolds Electric Company, 423 South Talman Avenue, Chicago, has developed a motor-driven controller or flasher.

Bell-Ringing Transformer

The "Liberty" bell-ringing transformer manufactured by the Betts & Betts Corporation, 511 West Forty-second Street, New York City, has been improved so that it does not interfere with the ordinary use of the socket to which it is attached.

Switch and Receptacle Box

Where junction or pull boxes are necessary and yet would be unsightly in finished walls or floors, the exposed switch and receptacle box made by the Trans-Com. Lighting Products Corporation, 508 Broome Street, New York City, may be used.

Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The Industrial Federation of Sweden has issued the first annual year book of reference concerning industrial firms, their personnel and the goods produced. The book contains 1200 pages and sells for 25 kroner (about $7).

A member of a firm of electrical supply importers in Australia (No. 28,728) is in this country and desires to be placed in connection with manufacturers of electrical machinery, specialties and supplies. He wishes to form business relations with manufacturers only.

A member of a firm in New Zealand (No. 28,749) is in this country and desires to secure an agency from manufacturers only for the sale of electrical supplies, electrical steel tool blanks, copper wire (plain and coated), woven-wire fencing, steel wire, etc.

ELECTRIC WASHING MACHINE AIRPLANE DELIVERY.—Airplane retail delivery began in Chicago March 11 at noon. Lieut. Ralph C. Diggins, formerly of the Ninety-second Aero Squadron, U. S. A., carried a 265-lb. Federal washer sold by the Commonwealth Edison Company in the

DELIVERING WASHING MACHINES BY AIRPLANE

cockpit of his Dayton-Wright biplane. The start was made from Grant Park, in the heart of Chicago, where the washer was unloaded from an electric truck into the airplane, and the flight ended 14 miles away at the suburban home of Mr. Dawes, a well-known banker. This is said to be the first time anything of this kind has been done in the United States. The feat is considered especially notable because the airplane was not changed in any way for the occasion.

HIGHER LAMP PRICES IN GERMANY.—As of Jan. 28, increases in the price of incandescent lamps have been made in Germany by the A. E. G., the Bergmann Company, the Osram Works, the Radium Electricity Company, Siemens & Halske and the Siemens-Schuckert Works. Under this arrangement, at 24 cents to the mark, the price of wire lamps with pear-shaped bulbs ranges from 72 to 90 cents; wire lamps in globe form are quoted at 86 cents to $1.68, and gas-filled lamps are at $1.20 to $2.64, exclusive of the lamp tax in each case. As the makers expect an improvement before long, it is said that the above prices have been calculated so as not to include the whole of the additional cost of production arising from the existing labor condition and other circumstances.

SWEDEN'S POWER-TRANSMISSION LOANS.—The Board of Trade and the Board of Agriculture point out in a joint memorandum to the Swedish government that applications for loans from the newly established power-transmission loans fund amount to about 6,000,000 kroner ($1,680,000). With reference to this the two departments consider that the state ought to assist the applicants to some greater extent than can be possible with the funds at present available, 1,000,000 kroner ($280,000) per year, to cover the loan requirements for the electrification of country districts. They therefore propose that a further sum of at least 1,000,000 kroner for each of the years 1919 and 1920 shall be granted for the purpose.

WAR SERVICE OF B. F. STURTEVANT COMPANY.—Without the addition of a single square foot of new factory building area, the plant of the B. F. Sturtevant Company, Hyde Park, Mass., passed from 10 per cent war work in April, 1917, to 90 per cent war service in November, 1918. The production of steam turbo-fans for destroyers increased 500 per cent from February to September, 1918, and at the latter time the company was practically equipping one destroyer per day with forced-draft outfits, the usual size of turbine being about 150 hp., designed for superheated steam service. For the Emergency Fleet Corporation many 15-hp. engine-driven fan units were completed, and the production rate was increased 350 per cent from February, 1918, to September without employing additional labor. This rapid and extended increase was accomplished largely by concentrating efforts on one type and two sizes of fan engines, 6-in. by 5-in., and 7-in. by 6-in. The company also supplied a large number of fans for forced-draft boiler-plant service and built economizers. One of the most important products of the company during the war has been gasoline-electric generating sets, built in sizes of 5 kw., 10 kw. and 15 kw., for portable service and also for use in fixed locations.

SOUTH AFRICA PREPARING FOR ELECTRIC VEHICLES.—The *British and South African Export Gazette* states that after peace the electrically propelled vehicle for transport, delivery and other purposes is expected to play a more important part in the business life of South African cities wherever electricity is available. Owing to the gasoline shortage and with an eye to future business, Cape Town, Port Elizabeth, East London and Durban are doing everything possible to extend the use of such vehicles. At Cape Town the charge per unit supplied is 2 cents between 11 p.m. and 8 a.m. and 5 cents during the remainder of the day. Energy is also supplied at special rates where the consumer guarantees to use 100,000 or more units per annum. At Port Elizabeth there is every facility afforded for the use of energy. The city electrical engineer of East London says that the municipality views electric vehicles very favorably and adds that a 2-cent charging rate during "off" hours may be looked forward to. Johannesburg already has the 2-cent charging rate. There the general post office has ten electric vehicles, which are used chiefly to collect the mails. There has already been some effort made to install electric vehicles upon a larger scale in the different public-service departments of the South African Union, but the high prices ruling have so far militated against progress being made in this direction.

BRAZILIAN ELECTRICAL IMPORTS.—Imports of electrical materials and machinery into Brazil showed a slight increase during 1917 as compared with 1916, Vice Consul Richard P. Momsen reports. Switzerland supplied a larger share of dynamos than the United States, but in electric motors the American article found preference, the shipments amounting to $100,297 out of a total of $167,800. Electric lamps, which formerly were supplied chiefly by Holland and Germany, are now being supplied by the United States, about 10 per cent of the imports being shipped by Holland. Imports of electrical machinery declined from $3,347,249 in 1913 to $1,594,389 in 1917, the United States being credited with $1,348,925 during 1917. Copper and other electrical wire was almost all imported from the United States. There follow details of electrical imports for 1916 and 1917:

	1916	1917
Dynamos and electrical generators	$83,080	$106,541
United States	43,500	35,817
Sweden	313	.....
Switzerland	26,062	55,337
Electric motors	123,465	167,800
United States	41,753	100,297
Great Britain	28,224	18,198
Switzerland	40,060	28,994
Insulators	74,626	101,835
United States	52,706	71,319
Great Britain	17,060	27,412
Lamps, electric	311,838	454,877
United States	237,199	369,936
Great Britain	14,293	17,494
Netherlands	39,571	54,824
*Machinery, electrical	1,126,311	1,594,389
United States	876,358	1,348,925
Great Britain	118,284	129,006
France	36,830	23,755
Transformers, electrical	152,313	107,279
United States	130,562	90,872
Great Britain	13,749	4,169
Wire, copper, electrical	355,605	360,502
United States	341,578	345,793
Great Britain	8,850	1,753
*Wire, copper	97,104	159,108
United States	84,624	148,590
Great Britain	8,466	9,320
Wire, copper, uninsulated	30,149	19,046
United States	27,241	19,046
Great Britain	2,280	.....
*Electric wire or cable	449,174	829,595
United States	380,534	721,697
Great Britain	34,381	18,642
Italy	25,810	21,115

* Not elsewhere stated.

THE ARGENTINA NAVAL COMMISSION announces that, effective Feb. 25, the offices of the commission will be at 2 West Sixty-seventh Street, New York, where all business will be transacted.

C. C. WALLACE, formerly manager of loading of the munitions section of the Stenotype Company, Indianapolis, Ind., is now director of development and service of the Powdered Coal Engineering & Equipment Company of Chicago.

JAMES E. BARKER, consulting engineer, announces the opening of offices at 611-615 Investment Building, Los Angeles, Cal., for the practice of gas, electrical and mechanical engineering, specializing in examinations, reports, appraisals, rate investigations, efficiency work for public utilities, and the design, construction and supervision of water, gas and electric systems.

J. E. SLIMP, who has for many years been connected with the sales department of the Ohio Brass Company, has resigned to become associated with H. C. Dodge of Boston, who is at the head of several manufacturing companies in New England. Mr Slimp will remain with the Ohio Brass Company until about April 1, and will be present at the A. E. R. A. mid-year meeting and dinner in New York as one of the Ohio Brass representatives.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., has purchased a tract of 20 acres in the northeastern section of Detroit, where plans are reported as being arranged for a plant to cost $750,000. The manufacturing business of the main plant at 1400 Russell Street is to be removed to this new location and the former plant used for other purposes. Completion of the new plant is expected to increase the company's facilities largely, making possible the employment of larger working forces.

THE INTERNATIONAL OXYGEN COMPANY of Newark, N. J., has opened offices in the First National Bank Building, Pittsburgh, Pa., in charge of R. A. Cornwall. Philip Wesley, formerly Pittsburgh representative of the company, has been placed in charge of the Chicago sales office in the Railway Exchange Building, Chicago. The British branch of the International Oxygen Company, known as the Integral Oxygen Company, Ltd., has commenced the manufacture of electrolytic cells and other products for the British market. E. L. W. Byrne is the general manager in charge, with offices at 38 Victoria Street, Westminster, London, S. W.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, has opened a Pittsburgh office at 305 Union Arcade Building. This office is in charge of E. S. Stickle, formerly connected with the W. A. McCombs Company.

R. L. HUTTO, St. Louis, Mo., has been appointed manager of the Delhi Battery & Supply Company, the St. Louis distributer for Prest-O-lite storage batteries. Mr. Hutto will give special attention to the service department and announces that a service engineer from the Prest-O-lite factory will soon be associated with him.

J. F. MACKIN, located at Columbus, Ohio, has become connected with the Black & Decker Manufacturing Company of Baltimore as representative throughout the entire State of Ohio. Mr. Mackin has been connected with the portable electric drill industry for years, his former connection having been with the Independent Pneumatic Tool Company.

C. D. WILLIAMS, former assistant manager of the Stuart-Howland Company, electrical supply jobber, Boston, has become general sales manager of the Efficiency Electric Company, East Palestine, Ohio, manufacturer of a line of industrial electrical devices. Prior to going with the Stuart-Howland Company Mr. Williams was sales manager for the Simplex Electric Heating Company, and before that he was connected with the Western Electric Company. Mr. Williams has been head of several of the important committees of the Westinghouse Agent Jobbers' Association.

W. D. HAMER, representative of the Electric Service Supplies Company, Philadelphia, has been transferred from his former territory in the Middle West to a Southern territory with headquarters in Atlanta, Ga. He has been connected with this company for fourteen years. Prior to 1905 he was employed in the stores and engineering department of the Lehigh Valley Railroad Company. In 1907, with the coöperation of the Nashville Railway & Light Company, he proposed and developed, what was reported to be the first prepayment car operated in the South. Mr. Hamer is also the inventor of the Keystone triangle arm.

THE CHICAGO PNEUMATIC TOOL COMPANY announces the following changes: Offices and warehouses have been opened at Tulsa, Okla., and El Dorado, Kan. The Boston office has been removed to 182 High Street, with F. S. Eggleston as district manager of sales. At this point a complete stock of repair parts will be carried for pneumatic and electric tools, air compressors, oil engines and rock drills. The Detroit office has been removed from 236 Hancock Avenue to 502 Farwell Building. J. I. Edwards has been appointed manager of the rock-drill sales division, succeeding E. Eklund, who has been appointed special foreign representative. Mr. Eklund will leave soon for Europe on business. Fred H. Waldron, formerly Minneapolis representative, has been appointed manager of the pneumatic tool sales division, succeeding J. G. Osgood, resigned. Mr. Waldron's offices are in the Fisher Building, Chicago. Nelson B. Gatch was recently appointed district manager of sales at Minneapolis, with affices in the Metropolitan Bank Building. J. K. Haigh has recently been appointed assistant district manager of sales in San Francisco, with offices at 175 First Street.

THE ELECTRIC VACUUM CLEANER COMPANY, INC., with principal offices in Cleveland, Ohio, and New York City, has filed articles of incorporation with the Secretary of State at Albany. The new concern is a consolidation of the business and manufacturing facilities of the Frantz-Premier Company of Cleveland and the vacuum-cleaner business of the Edison Electric Appliance Company of Chicago. It will be devoted to the manufacture and sale of electric vacuum cleaners (including stationary and portable types). It is understood that it will equip its output with General Electric motors. The present local service stations maintained by the Frantz-Premier Company will be extended and developed to give complete service to users of products of the new concern. The Frantz-Premier Company is one of the largest manufacturers of electric cleaning apparatus in the country. The directors of the new company are Julius Tuteur, Maynard H. Murch, John Sherwin, A. V. Cannon and E. W. Miner of Cleveland; F. S. Hunting of Fort Wayne, G. A. Hughes of Chicago, C. E. Patterson of New York, and A. K. Baylor of New York. This proposed incorporation was mentioned in the ELECTRICAL WORLD for Feb. 8, on page 290.

Trade Publications

VACUUM CLEANERS.—"Jewel" and "Quaker" vacuum cleaners are dealt with in a new folder of the Jewel Electric Company, 4714 Broadway, Chicago.

SEWING MACHINES.—Portable electric sewing machines are the subject of a recently issued circular from the Davis Sewing Machine Company, Dayton, Ohio.

AUTOMOBILE HEADLIGHT.—A folder about a new automobile headlight manufactured by J. T. Roffy, 340 Lewis Avenue, Brooklyn, N. Y., is being distributed.

REVERSE-PHASE RELAYS.—Type TS reverse-phase relays are the subject of a recently issued folder from the Palmer Electric & Manufacturing Company, Boston.

COOKING APPLIANCES.—A catalog of its electric cooking devices has been recently issued by the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City.

LEAD-BURNING TRANSFORMER.—The General Electric Company of Schenectady, N. Y., tells about its lead-burning transformer for arc-welding storage-battery connections in bulletin 3483-2.

TURBINES AND REDUCTION GEAR.—Bulletin No. 3 of the Moore Steam Turbine Corporation, Wellsville, N. Y., contains information regarding single-stage and multi-stage steam turbines and reduction gears.

OIL SWITCHES AND CIRCUIT BREAKERS.—Bulletin No. 433 prepared by the Condit Electrical Manufacturing Company of South Boston, Mass., contains information about type D-16 oil switches and circuit breakers.

MOTORS AND GENERATORS.—Various types of motors, generators, motor-generators, rotary-converters and ventilating fans are taken up in a loose-leaf catalog being distributed by the Fidelity Electric Company, Lancaster, Pa.

FARM-LIGHTING PLANT.—Instructions for installing, operating and maintaining type N of the Lay farm-light generator, which can be run by an automobile, have been issued in booklet form by the L. A. Young Industries of Detroit, Mich.

FLOODLIGHT PROJECTORS AND REFLECTORS.—The Crouse-Hinds Company of Syracuse, N. Y., has issued a sixty-three-page bulletin No. 304, covering Imperial floodlight projectors and reflectors. Besides complete descriptions, illustrations and lighting data, many unusual uses for these lights are shown.

STEEL TANKS AND BOILERS.—The Coatesville (Pa.) Boiler Works have recently published a cloth-bound and "profusely illustrated" book of ninety-six pages about its products. Many installations of its tanks, boilers and other heavy steel plate works are shown. Besides information about the works and their products the book has A. S. M. E. boiler specifications and other general data.

SYNCHRONOUS MOTORS.—In "The New Book of E-M Synchronous Motors" issued by the Electric Machinery Company of Minneapolis, Minn., particularly interesting sections of the forty pages are those containing comparative curves of the efficiency and power factor of synchronous motors and induction motors of corresponding ratings. The diagrams showing I²R losses reduced by placing condensers at various points on a system are also a noteworthy part of this exceptionally complete analysis of synchronous motors.

ASH-DISPOSAL SYSTEMS.—The American Steam Conveyor Corporation, 110 West Fortieth Street, New York City, and 326 West Madison Street, Chicago, has just issued a 160-page book entitled "Modern Methods of Ash Disposal." This is a presentation of methods of moving ashes, soot and combustion waste from boiler room to disposal station. Advantages and drawbacks of the different systems are very completely discussed in the front portion of the book, while the rest of it is devoted to photographs and information about various "American" fittings and installations of these devices. Interesting data on the coals of the United States and other tables are included in this well-prepared publication.

HIGH-TENSION CONDENSERS.—High-tension condensers, protective devices and other wireless equipment form the subjects of an illustrated folder recently issued by the Dubilier Condenser Company, 217 Center Street, New York City.

LIGHTING UNITS.—A lighting unit for home, store, office, assembly room, etc., made by the Dempsey-Glavin Electric Corporation, 408 West Thirty-fourth Street, New York City, is the subject of a folder prepared by the manufacturer and now being distributed.

BELL-RINGING TRANSFORMER.—The Betts & Betts Corporation of 511 West Forty-second street, New York City, has issued a folder containing information about its improved Liberty bell ringer. Proofs of advertising electrotypes about this transformer are printed on a card distributed to dealers.

INDOOR BUS SUPPORTS.—Addenda bulletin No. 31A has been prepared by the Delta-Star Electric Company, 2433 Fulton Street, Chicago, for filing with bulletin No. 31 and has for its subject unit-type indoor bus-supports. Space in this publication is also given to heavy-duty busbar supports and unit-type bus spacers.

POWDERED-FUEL SYSTEM.—The Quigley transport system for preparing, distributing and burning powdered fuel is the subject of bulletin No. 11 prepared by the Quigley Furnace Specialties Company, 26 Cortlandt Street, New York City. The pulverizing plant and other equipment used in the system are well covered by reading matter and illustrations, the latter including a detailed diagram of the coal-milling plant and the air-transport system. Shut-off valves, switching valves, controllers, burners, dust-tight gates, a fuel-bin gage, "cyclone" collectors and blast gates are described.

New Incorporations

THE WILLIAM J. RAINAUD LAMP COMPANY, 121-23 Lafayette Street, Newark, N. J., has been organized to manufacture lamps. William J. Rainaud, 308 Lafayette Street, Newark, is interested in the company.

THE ELECTRIC WELDING COMPANY OF BALTIMORE, 101 East Fayette Street, Baltimore, Md., has been incorporated by J. Bannister Hall, Hans Froelicher, Jr., and Thomas Swann. The company is capitalized at $150,000.

THE FEDERAL ELECTRIC COMPANY of Milwaukee, Wis., has been incorporated by E. A. Lambert, Frank Ziekursch and L. M. Wesser. The company is capitalized at $10,000 and proposes to manufacture electrical goods, supplies and accessories.

THE NATIONAL MACHINE & ELECTRIC COMPANY of High Point, N. C., has been incorporated by Herman E. Wood, Thomas G. Shelton and J. C. Smith. The company is capitalized at $125,000 and proposes to manufacture electric machinery, etc.

THE AMERICAN RAILWAYS SIGNALS COMPANY of Terre Haute, Ind., has been chartered with a capital stock of $200,000 to manufacture railroad signal devices. The incorporators are Thomas G. and Harry W. Beggs and John H. and John T. Beasley.

THE BUSHNELL MAGNETO CORPORATION of San Francisco, Cal., has been incorporated with a capital stock of $1,000,000 by J. B. Bushnell, W. T. Merriman, S. Hodson, L. W. Buck and W. S. Killingsworth. The company proposes to deal in electrical supplies, etc.

THE OZARK LIGHT & POWER COMPANY of Eureka Springs, Ark., has been incorporated with a capital stock of $100,000 to construct and operate an electric plant and street-car system, as well as manufacture and sell ice, etc. The officers are James Bowen, president; P. G. Walker, vice-president, and H. D. Jenkins, secretary and treasurer.

THE O. K. GIANT BATTERY COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,000,000 and proposes to do a general chemical and electrical engineering business. The incorporators are Samuel C. Wood, Arthur M. Brody of Chicago, Ill., and L. B. Phillips of Dover, Del.

New England States

DANVERS, MASS.—The Electric Light Commissioners have petitioned the town of Danvers for authority to purchase electricity from the Eastern Massachusetts Electric Company of Boston to be delivered at the switchboard to operate the municipal electric lighting system.

EASTHAMPTON, MASS.—The Turners Falls (Mass.) Power & Electric Company has purchased the electric power station at Mount Tom from the Easthampton Gas Company.

IPSWICH, MASS.—The finance committee of the Council has recommended that a committee be appointed to investigate the question of purchasing electricity from the Newburyport (Mass.) Gas & Electric Company to operate the municipal electric system. The extension of the electric lighting system to Linebrook parish is also under consideration.

WESTERLY, R. I.—At a recent meeting of the Board of Trade the members favored an amendment raising to $300,000 the bond issue of $100,000 for the construction or purchase of a municipal electric light plant in Westerly, passed some time ago by the State Legislature.

PLAINVILLE, CONN.—Estimates, it is reported, have been asked by Landers, Frary & Clark of New Britain, for the erection of a factory building, 60 ft. by 162 ft., four stories, and a power house, 42 ft. by 42 ft., in Plainville.

PUTNAM, CONN.—Bids, it is understood, have been received for the construction of an electric power house, 28 ft. by 40 ft., for the Nightingale Morse Mills in Putnam, to cost about $80,000.

Middle Atlantic States

ANDES, N. Y.—The question of replacing the present street-lighting system with electric lamps is under consideration.

BELMONT, N. Y.—The Village Board has been instructed to call a special election to vote on the proposal to appropriate $10,000 for the installation of an electric lighting system, provided that a satisfactory contract can be made with W. P. Clark for the purchase of electricity.

BROOKLYN, N. Y.—Application has been filed with the finance committee of the State Legislature by the Brooklyn State Hospital for appropriations to provide for improvements as follows: For the installation of additional power-plant equipment, $5,000; the installation of a new local telephone system and lighting of the institution grounds, $1,500 and $1,000 respectively; for the installation of a new fire-alarm system, $5,000; the installation of new electrical and mechanical equipment in the laundry, $65,000. Isham G. Harris is superintendent.

CENTRAL ISLIP, N. Y.—Application has been made to the finance committee of the State Legislature by the board of managers of the Central Islip State Hospital for an appropriation of $47,000 for improvements at the institution as follows: $15,000 for the installation of a new fire-alarm signal system, $30,000 for the purchase of new electrical and mechanical equipment, and $2,000 for improvements to the boiler equipment at the north colony.

MACEDON, N. Y.—The Town Board is considering submitting the proposal to issue $6,500 electric improvement bonds to the voters.

NEW YORK, N. Y.—Bids will be received by Thomas J. Drennan, fire commissioner, Municipal Building, New York City, until March 31 for furnishing and installing conduits, cables, wiring protector frame and appurtenances in the Manhattan Central office on Transverse Road No. 2, Central Park. Blank forms and further information may be obtained at the above office. A deposit of $5 will be required for specifications.

POUGHKEEPSIE, N. Y.—Plans are under consideration for extensive improvements at the Hudson River State Hospital, including the installation of new electrical equipment. Walter G. Ryan is medical superintendent.

NEWARK, N. J.—The Federal Adding Machine Company, York and Grove Streets, New Haven, Conn., is contemplating the erection of an experimental plant in Newark, to cost about $250,000.

ATHENS, PA.—Arrangements are being made to install electric lamps in East Athens to replace the oil lamps now in use. The Sayre (Pa.) Electric Company furnishes electrical service in Athens.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

BEATTY, PA.—Plans, it is understood, are being prepared for the construction of a power plant at the St. Vincent's College, to cost with equipment about $100,000. The Joseph A. Langdon & Sons Company, 608 Grant Street, Pittsburgh, is consulting engineer.

FELTON, PA.—An effort is being made to have the Edison Light & Power Company of York extend its electric transmission lines to Felton.

PITTSBURGH, PA. — The Pittsburgh Railways Company is planning to build an addition to its power house at McKee's Rocks, and also the erection of a new station at Castle Shannon.

PITTSBURGH, PA.—Plans are under consideration by the Aluminum Ore Company, a subsidiary of the Aluminum Company of America, Oliver Building, Pittsburgh, for the construction of a plant at Sollers Point, Md., to include machine shop, forge shop and a number of general shop buildings. A power plant will be erected, equipped with steam-driven electric generators of about 4000 kw. The equipment of the boiler plant will include a battery of marine-type boilers, equipped with automatic stokers, blowers and overhead coal bunkers. The cost of the plant is estimated at about $8,000,000.

BENWOOD, W. VA.—Bids, it is understood, will be received by S. G. Smith, Wheeling, receiver for the Benwood & McMechon Water Company, for equipping the plant for electrical operation, including the installation of motors, etc., and laying water pipe. G. H. Davies of Harrisburg, Pa., and S. H. R. Hudson of Pittsburgh, Pa., are engineers.

WASHINGTON, D. C.—Bids will be received by the superintendent of the United States Coast and Geodetic Survey, 205 New Jersey Avenue, S. E., Washington, D. C., until April 9 for an electrically driven milling machine for use in finishing the edges of electro-deposited copper printing plates, the sizes of which range from 18 in. by 24 in. to 38 in. by 48 in.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until April 25, Eastern and Western navy yards, Schedule 3858—miscellaneous bells and buzzers. Brooklyn, N. Y., Schedule 3889—11,000 ft. interior communication cable. Eastern navy yards, Schedule 3891—miscellaneous steel galvanized conduits and conduit fittings. Until April 22, Brooklyn, N. Y., and Norfolk, Va., Schedule 3880-100 storage batteries. Until April 28, Washington Navy Yard, Schedule 7885½—26-key resistance units, miscellaneous ammeter panels, 95 relays, 100 door switches, and 7175 antenna bus switches. Until April 4, Philadelphia, Pa., Schedule 7886½—two generator equipments. Newport, R. I., Schedule 7890½—20,000 ft. double-conductor cable. Further information may be obtained at the above office.

North Central States

DETROIT, MICH.—The Scripps-Booth Motor Company, it is reported, will erect a plant in Detroit, to cost about $1,500,000.

DETROIT, MICH.—Contracts, it is understood, will soon be awarded by the Central Forge Company, Euclid Avenue, for the construction of a steel heat-treating plant on Euclid Avenue near the Grand Trunk Railroad. Smith, Hinchman & Grylls, 710 Washington Arcade, are architects.

THREE RIVERS, MICH.—The Eddy Paper Company of White Pigeon is considering the construction of a plant in Three Rivers, to cost about $1,750,000.

AKRON, OHIO.—The Goodyear Tire & Rubber Company, it is reported, contemplates the erection of a new factory building, to cost about $500,000.

CLEVELAND, OHIO.—The Home Specialty Company is planning to erect a new plant on East 152d Street. The company manufactures electric washing machines.

CLEVELAND, OHIO. — Contract has been awarded by the Cleveland Automobile Company to the Crowell-Lundoff-Little Company for the construction of an automobile plant. A power plant is included in the plans. J. V. Whitbeck, chief engineer of the Chandler Motor Car Company, which is controlled by the same interests, is president. Ernest Woller is chief engineer.

DAYTON, OHIO.—Preliminary plans have been prepared for the construction of a factory for the Dayton Fan & Motor Company, South Ludlow and Bayard Street, to cost about $175,000.

TOLEDO, OHIO.—The Standard Oil Company of Ohio, Gas Building, has purchased a site northeast of the city on which it proposes to erect a large refinery, involving an initial expenditure of between $4,000,000 and $5,000,000.

WAUSEON, OHIO.—The City Trustees have been authorized to purchase wire, motors and other electrical equipment, pipe, pumps, etc., without advertising.

WHITESBURG, KY.—The Florence Mining Company, which has acquired the property of the Cumberland-Hazard Coal Company, it is reported, is contemplating improvements to the property, including the installation of electric equipment and opening new mines. L. H. Stone of Cincinnati, Ohio, is manager.

DECATUR, IND.—The Farmers Light & Power Company, recently organized with a capital stock of $5,000, proposes to furnish electricity for lamps and motors in Union and Root Townships from the Dent schoolhouse. John D. Nidlinger is president.

GARY, IND.—Work will soon begin on the construction of a large plant for the O. K. Battery Company in Gary.

INDIANAPOLIS, IND.—Plans are being prepared for the erection of a new factory building for the Motor Device Company. The capital stock of the company has been increased from $300,000 to $500,000. U. Z. Wiley of Indianapolis is interested in the company.

CENTRALIA, ILL.—The ice factory of the Centralia Ice Company, it is reported, has been purchased by the Duquoin Utilities Company. The new owner will install battery equipment and will operate the plant by electricity. William Farrell is manager.

SPRINGFIELD, ILL.—The contract for lighting the court house and county jail for the next year has been awarded to the municipal electric light plant.

APPLETON, WIS.—The construction of a plant for the manufacture of direct-connected generating units, farm-lighting systems and other electric equipment and appliances, to cost about $50,000, is reported to be under consideration by the Langstadt & Meyer Company. A. H. Meyer is secretary.

FOND DU LAC, WIS. — The Eastern Wisconsin Electric Company is contemplating extensions to its transmission lines.

JIM FALLS, WIS.—Plans have been prepared by the Wisconsin-Minnesota Light & Power Company of Eau Claire for the construction of a hydroelectric power plant at Jim Falls. E. A. Pierce of Eau Claire is vice-president and general manager.

STURGEON BAY, WIS.—Plans are reported to be under consideration by the High Falls Company to erect an electric transmission line from Green Bay to Sturgeon Bay. For further information address W. J. Wadsworth.

SUPERIOR, WIS.—Bids will be received by L. A. Nichols, secretary of board of education, Blaine School Building, Superior, until April 14 for construction of grade school building, including vacuum cleaning system, heating and ventilation, electric conduits and wiring, electric clocks and bell work.

BENSON, MINN.—Improvements to the municipal electric light plant, to cost about $30,000, are under consideration by the City Council. W. E. Skinner, Plymouth Building, Minneapolis, is engineer. Theodore K. Lee is superintendent.

CROOKSTON, MINN.—Steps have been taken by farmers residing between Crookston and East Grand Forks for the erection of an electric transmission line between the two cities.

OKLEE, MINN.—Improvements to the water and electric plant, to cost about $15,000, are reported to be under consideration.

ST. PAUL, MINN.—The Villaume Box & Lumber Company is reported to be in the market for twenty to thirty electric motors.

ST. PAUL, MINN.—Work has been resumed on the construction of the twelve-million-dollar union depot in St. Paul which was discontinued more than a year ago owing to the war. The Northern States Power Company is negotiating for a contract to furnish all electrical and steam service for the new building. The amount of electricity required is estimated at about 529 kw. The company is also negotiating with the Miller Hospital Association, which is erecting a new hospital, to cost $500,000, to furnish electrical service for the building, which will require about 260 kw.

BLOOMFIELD, IOWA.—A committee has been appointed by the City Council to make investigations relative to improvements to the municipal electric light plant. It is proposed to change the system from 110 volts, direct current, to 2300 volts, 60 cycles, three-phase, and to reconstruct the lines. New equipment consisting of a 225-kw. generator directly connected to a Corliss engine and a 100-kw. generating unit will probably be installed.

WEBSTER CITY, IOWA.—During a recent windstorm three smokestacks at the municipal electric light plant were blown down.

BUTLER, MO.—The City Council is considering improvements to the municipal electric light plant. The question of purchasing electricity from another town is also under consideration.

JAMESTOWN, N. D.—The proposal to issue bonds to establish a municipal electric light plant will be submitted to the voters at an election to be held April 7.

MITCHELL, S. D.—Bids will be received at the office of R. E. Davis, city auditor, Mitchell, until April 10 for improvements to the waterworks system, including material and equipment, separate bids to be submitted as follows: (1) Pumping station, well houses, machinery, foundations, etc.; (2) pumping station equipment, including one 2,000,000-gal. triple-expansion pump, one 37½-kva. generator and Unaflow engine, one 125-hp. boiler and auxiliaries; (3) alternate for No. 2, pumping station equipment, including two 60-kva. generators and Unaflow engines, one condenser, two 750,000-gal. and two 375,000-gal. motor-driven centrifugal pumps and auxiliaries; (3A) alternate for Nos. 2 and 3, pumping station equipment, including two 750,000-gal. and four 1,500,000-gal motor-driven centrifugal pumps and auxiliaries; (4) four motor-driven deep-well pumps of the working-barrel type, complete with starters; (5) alternate for No. 4, complete air-lift system for four wells, including pumps, piping and compressor; (6) three 12-in. wells, 159 ft. deep, including casing; (7) one 48-in. by 90-ft. brick or concrete stack; (8) one 200,000-gal. tank on 125-ft. tower. Bidders may combine two or more sections. Bids will also be received at the same time for cast-iron pipe, etc. Plans and specifications may be obtained from the city auditor upon deposit of $5, of which $3 will be refunded upon return of plans. Burns & McDonnell, Interstate Building, Kansas City, Mo., are consulting engineers.

CLARKSON, NEB.—Bids will be received by the village of Clarkson until April 2 for furnishing the necessary labor and material for rebuilding the electric light plant and pumping station, including power house, chimney, 80 ft. high, 3 in. inside diameter at top (bids will be received on concrete, brick and radial construction); one 115-hp., 277 r.p.m., Unaflow steam engine, one 90-kva., three-phase, 60-cycle, 2400-volt generator, complete with exciter; one three-panel switchboard; one 72-in. by 16-ft. fire-tube boiler, complete with breeching; one double-acting boiler-feed pump; one 150-hp. feed-water heater, and one two-stroke deep-well pump complete with 10-hp. motor and two 5-kva. transformers. Bids will be received on the entire work or separate sections. Plans and specifications may be obtained at the office of the Henningson Engineering Company, Omaha, upor deposit of $10. Plans are also on file in the office of the village clerk, Clarkson.

OMAHA, NEB.—Plans are being prepared by H. C. Christiansen & Company, architects, Chicago, Ill., for the construction of a large cold-storage plant for the Skinner Packing Company at Twelfth and Douglass Streets, Omaha, to cost about $500,000.

STERLING, NEB.—Bonds to the amount of $16,000 have been voted for the installation of a municipal electric lighting system in Sterling.

INDEPENDENCE, KAN.—Arrangements are being made to replace the arc lamps now in use with tungsten lamps. Plans are also under consideration for the installation of a new ornamental lighting system.

OSWEGO, KAN.—The City Council has engaged A. C. Moore of Joplin, Mo., engineer, to prepare plans for the proposed municipal electric light plant.

ROSEDALE, KAN.—The State Legislature has appropriated $150,000 for a power plant for the Rosedale Hospital.

Southern States

RALEIGH, N. C.—The Carolina Power & Light Company is contemplating extending its system from Goldsboro to Mount Olive.

ALMA, GA.—An election will be called to vote on the proposal to issue $15,000 in bonds for the installation of a municipal electric light plant.

PENSACOLA, FLA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 7, under Specification 3785, for electrical equipment at Pensacola. The cost is estimated at about $30,000. A deposit of $10 will be required for plans.

NASHVILLE, TENN.—At an election to be held April 3 the proposal to issue $60,000 in bonds for the installation of a boiler in the electric light plant will be submitted to the voters.

MOBILE, ALA.—The Mobile Electric Company, controlled by H. M. Byllesby & Company, 208 South La Salle Street, Chicago, Ill., has decided to construct a new power plant at some point on the Mobile River or Three Mile Creek, the site to be selected, at a cost of about $1,000,000. The new plant will be erected in addition to the present power house at Royal and St. Anthony Streets, which was partly wrecked by an explosion on Feb. 21. T. K. Jackson of Mobile is manager.

LEXINGTON, MISS.—The city of Lexington would like to receive estimates on the cost of furnishing and erecting a complete electric light plant for the municipality. Both stream and oil engines will be considered. W. L. Jordan is city clerk.

SENATOBIA, MISS.—The City Council has authorized an issue of $15,000 in bonds for the installation of a new electric light and water plant. The new plant will furnish electricity for Coldwater, 6 miles distant, and for the County Agricultural High School. The present municipal plant has been in service for about fifteen years.

FORT SMITH, ARK.—The Majestic Coal Company of Fort Smith, recently organized, is in the market for mining machinery and power-plant equipment. W. J. Pendergrass is interested.

TEXARKANA, ARK.—The Southwestern Gas & Electric Company is planning to rebuild its carhouse and shops, recently damaged by fire. The loss is estimated at about $150,000.

DUNCAN, OKLA.—Bids will be received by the city of Duncan until April 1 for furnishing material and equipment and installing same for waterworks and electric light plant, including two 160-hp. engines, complete with all accessories, directly connected to 100-kva., three-phase, 60-cycle, 2300-volt generators, with exciter and rheostats. Alternate bids will be received for furnishing and installing oil and natural-gas engines directly connected to 100-kva. generators; one five-panel switchboard and power wiring; one 350-gal. per minute, 100-lb. head, two-stage, centrifugal pump, directly connected to 40-hp. 2300-volt, three-phase, 60-cycle motor; two 40-hp., 2300-volt, three-phase, 60-cycle motors, belt drive; one 60-hp., 2300-volt, three-phase, 60-cycle motor, to be directly connected to present pump, and one pump house complete. Bids will be received on any or all of the above equipment, but preference will be given bids covering all the above items. The Benham Engineering Company, Colcord Building, Oklahoma City, is consulting engineer.

AUSTIN, TEX.—The City Council has appropriated $10,000 for placing cables in conduits, the work to be done by the Water and Light Department.

DALLAS, TEX.—Wiley Blair, chairman of the committee of the Dallas Chamber of Commerce, which is promoting the construction of an interurban electric railway between Dallas and Wichita Falls, a distance of 125 miles, has announced that funds for the survey of the proposed railway have been raised. A similar project is being promoted by the Dallas Northwestern Traction Company.

SUGAR LAND, TEX.—The Sugar Industries, operating the Imperial Sugar Company, Sugar Land Manufacturing Company, Sealy Mattress Company, Imperial Mercantile Company and Sugar Land Feed Company, contemplates the construction of an electric power house to supply electricity to all of its departments. The plans provide for the installation of two generating units of 500 kw. each. G. D. Ulrich is vice-president and general manager.

Pacific and Mountain States

KALMATH FALLS, ORE.—The California-Oregon Power Company is considering the construction of a dam across the Link River in connection with the use of the large power plant at Copco, Cal.

GLENDALE, CAL.—The Board of City Trustees has authorized plans to be prepared for the construction of a municipal electric light plant. It is proposed to utilize water power to be developed in connection with extensions to the municipal waterworks system. The cost of the entire project is estimated at about $175,000. H. B. Lynch, Central Building, Los Angeles, is engineer.

HOLTVILLE, CAL.—The Holton Power Company is planning to erect a 15,000-volt transmission line from El Centro to Calexico to supply electricity to the entire Imperial Valley. This line replaces a small line erected thirteen years ago. The plans include the construction of a new substation at Brawley, the installation of new equipment at the Holtville station and a new line between El Centro and Brawley.

LOS ANGELES, CAL.—The Bonnie-Reed Film Manufacturing Company of Niles contemplates the construction of a motion-picture plant, including studios, offices, laboratories, warehouse, grand stands, power plant, etc., on Sunset Boulevard and Bronson Avenue, to cost about $1,000,000. Train & Williams, Exchange Building, are architects.

OGDEN, UTAH.—Plans are being prepared by M. C. Couchot, engineer, 110 Sutter Building, San Francisco, Cal., for the construction of an elevator and flour mill for the Sperry Flour Company in Ogden, to cost about $300,000.

SNOWFLAKE, ARIZ.—The Snowflake & Taylor Irrigation Company is contemplating the installation of an electric light plant to supply electricity for lamps and motors in the towns of Snowflake, Taylor and Shumway in Navajo County.

LAMAR, COL.—The Public Utilities Commission has authorized the city of Lamar to call an election April 1 to vote on the proposal to issue $45,000 in bonds for the construction of an electric light and power plant. Electrical service is now supplied by the Intermountain Railway, Light & Power Company.

LOVELAND, COL.—Bids will be received by the city clerk of Loveland, City Hall, Loveland, Col., until April 1 for approximately 109 ornamental single lamp posts and 10,000 ft. of three-conductor, 600-volt underground wire. Plans and specifications may be seen or obtained at the above office.

Canada

EDMONTON, ALTA.—The construction of a new telephone plant, to cost about $900,000, is under consideration by the Public Utilities Commission.

WINNIPEG, MAN.—The provincial government has appropriated $350,000 to assist in the erection of an electric transmission line from Winnipeg to Portage la Prairie. The total cost is estimated at $700,000.

COBOURG, ONT.—The Hydro-Electric Power Commission of Ontario is planning to erect a planing mill at Cobourg, to cost about $60,000.

ROCKLAND, ONT.—Bids, it is understood, will soon be asked by W. C. Edwards & Company, Ltd., Sussex Street, Ottawa, for the construction of a pulp and paper mill in Rockland, to cost about $3,600,000.

THREE RIVERS, QUE.—The International Paper Company, 30 Broad Street, New York, N. Y., is considering the construction of a paper-manufacturing plant in Three Rivers, to cost about $3,000,000.

CRAIK, SASK.—The installation of a municipal electric light plant in Craik is under consideration by the city officials.

MOOSE JAW, SASK.—Extensive improvements will be made to the municipal electric light plant, which with proposed line extensions will involve an expenditure of about $223,000. The installation of a 3000-kw. turbo-generator is included in the plans.

(Issued Feb. 18, 1919)

1,294,679. METHOD OF JOINING METAL PLATES; Maurice Lachman, New York, N. Y. App. filed June 19, 1918. Rivet passed through hole in one plate and welded to other one.

1,294,680. METHOD OF UNITING PLATES; Maurice Lachman, New York, N. Y. App. filed June 19, 1918. Weld localized in portion of meeting surfaces.

1,294,691. SELECTING DEVICE FOR ELECTRIC BELLS AND THE LIKE; William E. Muntz, London, Eng. App. filed Sept. 5, 1914. Gives distinctive call according to location of caller.

1,294,694. ELECTRODE FOR VACUUM DISCHARGE DEVICES; Henry J. Nolte, Schenectady, N. Y. App. filed Aug. 7, 1918. Anode always maintained in desired relation to cathode and grid.

1,294,695. WATER HEATER; Clark M. Osterheld, Stoughton, Wis. App. filed Sept. 25, 1915. Heats flowing water in pipe or duct leading to faucet or aperture.

1,294,722. TELEPHONE SYSTEM; Roy H. Smith, Philadelphia, Pa. App. filed April 22, 1918. No interference between controlling apparatus of signals installed at different operators' positions.

1,294,744. SEAL FOR CONDUITS; William W. Wotherspoon, New York, N. Y. App. filed April 23, 1912. Liquid paraffin introduced and allowed to harden.

1,294,756. TUNNEL KILN; George H. Benjamin, New York, N. Y. App. filed May 21, 1917. Combines features of "direct fire" and "muffle" type.

1,294,784. MAGNETIC BRAKE; Earl J. Ferry, King City, Cal. App. filed March 11, 1918. For motor vehicles.

1,294,790. FIXTURE SUPPORT; Frederick A. Godfrey, Chicago, Ill. App. filed Dec. 19, 1917. Expedites fastening stud to outlet box and reduces number of bolts.

1,294,794. PULL SOCKET; Mark J. Gretsch, New York, N. Y. App. filed May 12, 1917. Chain operates cam, which in turn controls contacts.

1,294,830. ELECTRIC ARC FURNACE; Ivar Rennerfelt, Djursholm, Sweden. App. filed Aug. 24, 1916. May be used directly on lighting circuits without special starting devices.

1,294,837. ELECTRIC FURNACE; Frederick von Schlegell, Evanston, Ill. App. filed Nov. 25, 1918. Reduces loss of metal due to volatilization.

1,294,841. TELEPHONE SYSTEM; Frank M. Slough, Rochester, N. Y. App. filed March 20, 1917. Number of telephone line upon which service is being given may be indicated to observer.

1,294,862. ELECTRIC SWITCH; Ernest O. Bennett, Bluefield, W. Va. App. filed July 13, 1917. Spring-actuated contact or pair of contacts primarily receives blade of knife switch.

1,294,878. LEVEL; Michael H. Constantine, Franklinville, N. Y. App. filed June 8, 1918. Electrically illuminated.

1,294,880. FUSE; George Denman and Edward F. Lewis, Terre Haute, Ind. App. filed March 27, 1918. When primary fuse burns out current is automatically transferred to secondary auxiliary fuse.

1,294,894. RECTIFYING COMMUTATOR; Harry A. Froom, Worcester, Mass. App. filed Nov. 12, 1915. Converts direct current into alternating current for spark coil of ignition system.

1,294,899. LOCKING MASTER SWITCH FOR ELECTRIC SYSTEM; Ardashes M. Gulamerian, Summit, N. J. App. filed Aug. 8, 1916. For motor-driven vehicle.

1,294,923. TIRE ALARM; Jeremiah C. Long, Everett, Mass. App. filed Feb. 21, 1916. Alarm sounded when pneumatic tire becomes deflated.

1,294,974. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed Oct. 6, 1916. Air controlling valve device automatically operates to control brakes if electrical control fails.

1,294,975. DEVICE FOR ELECTROPNEUMATIC BRAKES; Walter V. Turner, Wilkinsburg, Pa. App. filed Oct. 21, 1916. Prevents release of brakes in changing ends on double end brake.

1,294,983. STATION FOR WIRELESS TELEGRAPHY AND TELEPHONY; George von Arco and Alexander Meissner, Berlin, Germany. App. filed Dec. 27, 1912. High-frequency current generated by machine.

1,295,007. CIRCUIT BREAKER; William Corley, Washington, D. C. App. filed April 26, 1918. For use in submerged naval mining operations to break circuit under abnormal conditions automatically.

Record of Electrical Patents

Notes on United States Patents

1,295,009. METHOD OF UNITING METAL BODIES; Lawrence P. Crecelius, Cleveland, Ohio. App. filed April 30, 1915. Reduces current and time required.

1,295,020. ELECTRIC BRAKE SYSTEM; Nathan Fallek, Denver, Col. App. filed June 30, 1915. For vehicles.

1,295,040. MULTIPLE SWITCH; Charles H. Kenney, Milwaukee, Wis. App. filed Feb. 26, 1914. May operate independently or automatically.

1,295,045. ELECTROTHERMIC FURNACE FOR THERAPEUTIC PURPOSES; Tiodolf Lidberg, Chicago, Ill. App. filed March 4, 1918. Small quantities of liquid may be heated or evaporated, or instruments cleansed and sterilized.

1,295,048. METHOD OF AND APPARATUS FOR BENDING TUBES; Harry P. MacDonald, Montclair, N. J. App. filed Dec. 23, 1916. Article may be heat-treated while in bending apparatus.

1,295,080. EXTRACTION OF ZINC; Henry L. Sulman and Hugh F. K. Picard, London, England. App. filed Jan. 20, 1917. Neutralization of last portions of acid with which ore is treated quickly completed by addition of zinc hydrate.

(Issued Feb. 25, 1919)

1,295,095. TROLLEY REPLACER; Harry G. Albietz, St. Louis, Mo. App. filed June 21, 1918. Traveling spool on pole contacts with wire and guides trolley wheel to wire.

1,295,096. TELEPHONE SYSTEM; Albert Andersen, Chicago, Ill. App. filed Oct. 24, 1913. Call signal omitted in substation circuit, subscriber being signaled through receiver.

1,295,100. ELECTROLYTIC REFINING OF METALS; Blasius Bart, Newark, N. J. App. filed Dec. 12, 1917. Entire supply of metal used in eletcroplating is evenly consumed.

1,295,113. INDICATOR; Donald E. Burger, Mount Vernon, N. Y. App. filed Nov. 21, 1917. Used as street or station indicator for car and display advertising.

1,295,121. INDICATOR; Jacob Cartun, Philadelphia, Pa. App. filed June 30, 1916. Motor-car signaling device.

1,295,122. ELECTRIC BATTERY; Rufus N. Chamberlain, Chicago, Ill. App. filed Feb. 16, 1917. Rechargeable dry cell inexpensively made.

1,295,144. STARTER FOR INTERNAL-COMBUSTION ENGINE; Frank E. Fisher, Detroit, Mich. App. filed Feb. 18, 1918. Front cover plate of engine cylinder supports electric starting and generator unit.

1,295,168. KNOCK-OUT FOR ELECTRICAL BOXES; Duncan C. Hooker, Farmington, Conn. App. filed June 27, 1918. Caused to rotate on uncut portions of metal as pivots, easily twisting off.

1,295,175. AUTOMATIC TELEPHONE SWITCHING APPARATUS; Alexander E. Keith, Hinsdale, Ill. App. filed Sept. 25, 1914. Rotary or non-numerical switch.

1,295,181. TELEPHONE-EXCHANGE SYSTEM; Fritz Lubberger, Chicago, Ill. App. filed Dec. 10, 1919. Subscriber may call another of same group without extending call through main station.

1,295,185. ROTARY CONNECTOR; Trygve E. Meyer, Lombard, Ill. App. filed Feb. 18, 1914. Proper operation by subscriber insured.

1,295,191. WIRING CONNECTION FOR AUTOMOBILE LIGHTS; Frank E. Mullin, Pennant, Saskatchewan, Canada. App. filed June 2, 1917. Spaced loops in doubled wire fit on binding posts and extended eye at one end attaches to conductor.

1,295,227. RAIN ALARM; Arnold T. Soderquist, Dalbo, Minn. App. filed July 7, 1917. Depressing balance rings bell.

1,295,229. TELEPHONE-EXCHANGE SYSTEM; Arthur B. Sperry, Chicago, Ill. App. filed July 28, 1908. Permits connection of private branch exchange with automatic central system.

1,295,245. METHOD OF AND APPARATUS FOR RADIO SIGNALING; Roy A. Weagant, Roselle, and Harry Shoemaker, Jersey City, N. J. App. filed Jan. 6, 1916. Excludes interference from electromagnetic waves of different frequency.

1,295,278. GENERATOR; Bruce W. David, Cleveland, Ohio. App. filed March 20, 1915. Automatically takes care of plurality of welding arcs, independently of interposition of loading resistance in circuit.

1,295,285. ELECTRIC GAS LIGHTER; Roy F. Dowdy, Roanoke, Va. App. filed March 23, 1918. Attaches to screw-base receptacle.

1,295,309. ELECTRIC FURNACE AND METHOD OF OPERATING THE SAME; Jervis R. Harbeck, New York, N. Y. App. filed April 24, 1917. Static-fluid cooling system.

1,295,365. STORAGE-BATTERY PLATE AND METHOD OF BUILDING; John M. Peterson and Alvin O. Retrum, Dawson, Minn. App. filed Dec. 11, 1917. Thin leaves radiating from base receive active material.

1,295,389. RECTIFIER FOR AUTOMOBILE GENERATORS; Lee R. Titcomb, Danville, Ill. App. filed Dec. 24, 1917. For Ford magnetos.

1,295,405. TELEPHONE-EXCHANGE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed March 3, 1917. Apparatus charges call only if connection is successfully established.

1,295,410. THEFT SIGNAL FOR VEHICLES; Bruno Zabel, Edgewood Borough, Pa. App. filed Dec. 7, 1917. Bells ring when brake is released.

1,295,416. AIR-CONDITIONING APPARATUS; Arthur F. Berry, London, Eng. App. filed Aug. 10, 1916. Air passed over electric heater and mixed with cooler air.

1,295,435. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 26, 1917. Calling party's connection to private branch exchange line maintained while called party obtains connections without aid of operator and converses with third party.

1,295,445. CONTROLLER FOR MOTOR-DRIVEN VALVES AND OTHER DEVICES; Peter P. Dean, New York, N. Y. App. filed Sept. 14, 1916. Substantial jamming action at limits of movement of driven part provided for.

1,295,454. TRANSMISSION CIRCUIT; Henry C. Egerton, Passaic, N. J. App. filed Aug. 30, 1916. Amplifier does not cause excessively loud side tone in loud-speaking receiver when local transmitting apparatus is used.

1,295,457. ELECTRIC WELDING TOOL; George A. Engstrom, Topeka, Kan. App. filed Feb. 18, 1918. Handle cooled by ventilation and rotated without breaking circuit.

1,295,459. ELECTRIC BATTERY; Raymond W. Erwin, Fremont, Ohio. App. filed April 15, 1915. Granular oxide prevented from sifting through perforated container of cell electrodes during handling.

1,295,464. GRADED INSULATION; Giuseppe Faccioli, Pittsfield, Mass. App. filed Jan. 2, 1917. Terminal insulator has material omitted at some points and concentrated at others without impaired insulating qualities.

1,295,475. DRY CELL; Harry F. French and Raymond C. Benner, Fremont, Ohio. App. filed Aug. 23, 1916. Layer of paper or cloth omitted between zinc and mix.

1,295,481. VACUUM TUBE; Alfred Greiner and Francis J. Farrelly, Hartford, Conn App. filed Nov. 28, 1914. Valve tube prevents change of polarity of current and guards X-ray tube in circuit.

1,295,487. SYSTEM OF AUTOMATIC CONTROL FOR MOTORS; William S. H. Hamilton Schenectady, N. Y. App. filed March 18 1918. For motor-operated cooling means for electrical apparatus.

1,295,497. PORTABLE ELECTRIC LAMP; Harry Henderson and Arthur E. Case, Marion, Ind. App. filed Sept. 30, 1916. Body formed of a single sheet of metal.

1,295,498. SYSTEM OF ELECTRICAL DISTRIBUTION; Edward M. Hewlett, Schenectady, N. Y. App. filed March 9, 1917. Controlling means for circuits of plurality of electric conductors.

1,295,499. SYSTEM OF ELECTRICAL DISTRIBUTION; Peter Cooper Hewitt, Ringwood Manor, N. J. App. filed Dec. 13, 1913. Periodic variations produced by mutual interaction of conducting gas or vapor and magnetic lines of force.